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JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania

AND

MECHANICS' REGISTER.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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JOURNAL

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JULY, 1839.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Further Notice of the Fallacies of Mr. Espy's Examinations of Storms. By W. C. Redfield.

Storm of August 17*th*, 1830.—When my last remarks on the fallacies of Mr. Espy's examinations of storms were sent to press, his comments on this storm, in the May number of this Journal, had not appeared. The readers of the journal will not find, however, in this closing portion of Mr. Espy's examinations, any return to the correct principles of critical analysis, nor any facts which invalidate my former conclusions in regard to this storm.

Could Mr. Espy have shown that the distinctive features of this storm had not been clearly developed or rightly apprehended, and, by a more strict analysis, have pointed out the error of my previous inductions, his labours might have proved of some benefit to the cause of science. But the attempt to merge all the distinctive and well marked phenomena of this storm into one chaotic mass of generalities; to confound one of the most strongly marked hurricanes of the Western Atlantic, with the clouds and rain which occurred the same week at certain localities; and to mingle this hurricane with the phenomena of another, which followed a few days later on a different track, can neither add to our knowledge, nor settle a controverted question of fact. Yet his professed examination of this storm is liable to even more than these objections; while he sets out with new and fancied conclusions, which appear at variance with the great mass of observations which he has recited.

After the exposition which has been made, in the May and June numbers of this Journal, of the errors of Mr. Espy's previous positions and examinations, it cannot be expected that I should follow him in detail, through the mazes of error and confusion into which he has fallen; and the pointing out of a few more of these errors will suffice to show that his conclusions, in regard to the distinctive phenomena of our great storms, cannot be relied on.

Mr. Espy sets off with the affirmation, that "this storm, if indeed it was one, and not many, was upwards of 1000 miles long from N.N.E. to S.S. W., and at least five times as long as it was broad on the 17th." [!] It is true, that at least three hurricanes passed our coast in the month of August, 1830; but it is too late to attempt the blending of these separate and distant storms into one grand but indeterminate generalization, as Mr. E. has done with some other cases, in his capacity of meteorologist to the joint committee. But what is the evidence by which such a remarkable elongation in this storm is supposed to be established? Simply, that the brig Mary took the gale on the 14th, in lat. 27° 55′, lon. 76° 50′, which Mr. E. says, "lasted till the 17th, and that on the same day, the storm was felt at several points N.N.E. of brig Mary, as far as Long Island Sound." To this sweeping method of settling this important question, I have several objections.

1. The points at which the storm is mentioned on the day of the 17th, are all northward of Cape Hatteras, which itself is little more than *four hundred* miles from Long Island Sound; and the storm did not reach the latter till late in the day, after having left the former region. 2. In nearly five pages of summary recitals of the phenomena of this storm, which are quoted by Mr. Espy, we find nothing to confirm this statement of three days duration; while in several of these it is expressly stated as being less than 24 hours. 3. The brig Mary, when in the gale on the 14th and 15th, was near the latitude of recurvation, (30°) where the duration of the gale is often increased. 4. The report of the brig Mary does not state that she was in the gale on the 17th, which must have been impossible, according to numerous and detailed accounts. This report, as I find it, and as afterwards quoted by Mr. Espy, says, that the Mary "experienced a tremendous gale on the 14th," &c., "which lasted three days." Thus, if there be no greater error, it must simply mean a portion of three several days, according to verbal usage from time immemorial, i. e. beginning, probably, on the evening of the 14th, continuing through the 15th, and ending on the morning of the 16th. As the vessel was then steering for Charleston, under the heel of the gale and the power of the gulf stream, this duration, on a rapid course to the northward in that region, is sufficiently conformable to the other facts obtained. But to assume, as is boldly done, that the storm extended, on the 17th, from Long Island Sound to the first position of the Mary, is to nullify nearly all the other accounts of this storm. What credit can be claimed for the conclusions of a meteorologist, when arrived at in this extraordinary manner?*

But this is not all; for, as if the above assumption was not sufficiently at variance with the facts of the case, we are next told, that "on the 18th, its length [that of the storm] appears to be still greater, for it seems to have reached from lat. 28°, lon. 66°, where the wreck of the Julia was seen on that day, [?] to lat. 41° 20′, lon. 65° 25′, where the hurricane was tremendous from N.N.E."

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* On examining the report of the brig Mary, as published in the newspapers, I find it also states, that on the 17th, at 10 A. M., 60 miles S. of Charleston light, the Mary took off the crew of the Br. barque Prospect, which was in a sinking condition; "she having experienced the same gale on the 15th and 16th." Thus, instead of having "lasted *till the* 17*th*," the report itself shows that the gale terminated in that quarter on the 16th!

The schr. Ward, which took the gale in the same region, reports its duration at 36 hours, which agrees with my explanation, and shows that it must have ended early on the 16th.

The reader will be equally astonished with myself, at finding, on research, that this second attempt to elongate this storm, is founded on nothing more than the simple fact, that "*the Ceres fell in with the wreck of the Julia*, in lat. 28°, lon. 66°"!—as if meeting a wreck, proved the presence of a hurricane![*]

Had our sagacious examiner but noticed the log of the Blanche frigate, which is given in the work which he was professedly examining, he would have found, that in a position some hundreds of miles nearer to the storm, this ship had no gale on the 17th or 18th; and that on the latter day, she had the winds "moderate," "light airs," and "calm."

Thus, we have no need to settle the pretty speculation, "whether this storm traveled side foremost exactly, or not:"—nor can we find reason to doubt, that on the 17th and 18th, "it certainly moved towards the eastward!"

The discrepancies of one or more hours in the common newspaper accounts of the beginning of the gale, at different towns in the Carolinas, do not require any consideration, as we have in our hands the data for their correction. A little research would have satisfied Mr. E., that the statement which fixes the storm at Wilmington, N. C., on the evening of the 15th, was a typographical error of one day: the true account says on the 16th, in accordance with the reports from other localities.[†] Besides this and like errors, Mr. Espy quotes those marine reports in which the date is given in nautical time, without correction; in cases where the fact is perfectly obvious. We find in his additional collections, scarcely a new fact that bears on the case, chiefly for the reason that the most important of these were already embodied in my statements; while errors in date, the want of geographical and consecutive arrangement, and the placing in juxtaposition of distant and irrelevant phenomena in these additions, are well calculated to promote the same degree of confusion in the mind of the reader, that appears to exist in Mr. E.'s own conceptions of this storm.

As instances of the confusion produced by juxtaposition, and the error or omission of dates, the following may be noticed:—

"On the 18th, in lat. 43°, lon. 58°, heavy gale from the southward. Off the Highlands, blowing very heavy from the northward."[‡]

This, when correctly exhibited, proves to be the report from the packet ship Edward Bonaffe of the gale on the 18th, with the additional but irrelevant fact, that on arriving off the Highlands, *about ten days later*, the ship split some of her sails, the wind blowing heavy from the northward!

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[*] National Gazette, of Sept. 30, quoted by Mr. Espy. The account, *in extenso*, as I find it in the New York Gazette, of Sept. 28th, is as follows:—"Br. barque Ceres arrived at St. Andrews, N. B., 18th Sept. from the West Indies. In lat. 28°, lon. 66°, fell in with the wreck of schr. Julia, of Newbern, N. C., and took from her some pork, lard, &c.; also the crew of said schooner, excepting the captain and one man, lost. The Julia was lost in the gale of the 20th of August."

How could such a statement have been made the basis of so important a position relating to the extension of the hurricane which was off Nova Scotia, on the 18th?

[†] See New York Evening Post, August 26th.

[‡] May number of this Journal, p. 291.

Of the same character is the fact, that "at New Orleans it blew a gale between the 15th and 20th."

Of Mr. Espy's errors in date or geographical position, I will only mention further, his position of the ship Brilliant, on the 18th, in lon. 71°, bound to Philadelphia. This ship, I find, is reported as being spoken by the brig Othello from Bremen, on the 18th, in lon. 64°. Also, the Henry Astor, on the 19th, in lon. 68° 24′, (?) *on her route from New Orleans to New York!* These and like errors and crudities, ought not to have been thrown as stumbling blocks in the path of scientific investigation.

The wholesale generalizations, "that on the 17th, the wind on the Atlantic, some distance from the coast, was blowing from the S.E. all the way from Georgia to Maryland, and at the same time on shore for that whole distance, it was blowing from the N.W.; and that N.E. of Maryland, as far as Long Island Sound, the wind was N.E.," &c., are of the same general character with other phenomena which he has alleged as occurring "at the same time," and which have recently received our consideration.* It will appear, on strict examination, that here was the regular action and progress of a whirlwind storm; the wind *blowing across the centre of its path*, first from S.E., and last from N.W., in regular succession, from Georgia to Massachusetts; and that after passing Virginia, the storm so far left our shores as to blow from the N.E. on the land and near the coast, or *retrograde* to the course of the storm; while on its opposite margin, at sea, the wind blew from the S.W.: all which demonstrates the rotary character of the storm. Are we to suppose that the *accepted test* for the two theories was forgotten by Mr. E., while penning the above generalization?

Mr. Espy sums up the results of his professed examination of this storm in the three following positions:—

1st. That "the storm was several hundred miles longer from N.N.E. to S.S.W., than it was from W.N.W. to E.S.E." We have seen both the error and futility of this conclusion.

2d. That "it moved eastward with a velocity not exactly ascertained," &c. That it moved eastward in these latitudes, has been known since 1830; and its velocity, having been observed through a course of near 3000 miles, is better understood than Mr. E. appears willing we should believe.

3d. That "the wind set in generally, out at sea, from the S.E., and changed round to N.W." This appears a correct, but fatal admission. Has Mr. Espy forgotten the storm of 1821, which he strenuously contended, never changed from S.E. to N.W.? In view of this admitted fact, what becomes of the centripetal theory?

I had long been curious to know, how Mr. Espy would deal with the facts which pertain to this storm of August 17th, 1830, and other distinctly marked hurricanes: but must now acknowledge that I did not anticipate so complete an evasion of all the distinguishing points at issue, and so barren an effort at confusing and mystifying the most distinct phenomena of this storm, as is manifested in his present examination. We are greatly indebted to him, however, for having spread before his readers, though in an exceptionable manner, a summary of the principal facts in relation to this storm: many of whom will doubtless investigate the subject for themselves, free from the bias of a preconceived hypothesis.

New York, June 26th, 1839.

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* See the refutation of Mr. Espy's positions relating to the storm of Sept. 1821, in the May and June numbers of this Journal for the present year.

Experiments on the Porosity of a Mass of Cotton.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir:—

Perhaps you may consider the following pretty experiment on porosity, worthy of a place in your Journal. Fill a common glass tumbler, or other vessel, completely with some spiritous liquor, so that a few drops more would cause it to overflow. This done, you will find no difficulty in introducing into the tumbler, so filled, *a whole handful of raw cotton.*

This experiment was suggested by the accidental recovery of some wet cotton from a boat which had been sometime sunk in the Tennessee river; it was found by the workmen that after they had squeezed out the water from some cotton, the vessel in which it had been contained, remained nearly as full as before the cotton was removed.

Spirits answer better than water, for trying the experiment, from the rapidity with which they are absorbed by the cotton. Several theories were started by persons who tried the experiment; such as, that the filaments of cotton occupied the vacancies between the globules of water; or that by its capillary action, the cotton subdivided the globules, and caused them to occupy a less space, &c.; to me, however, it appears to be accounted for more satisfactorily, by supposing the fluid to insinuate itself between the filaments of cotton, and thus permit the latter to occupy no more space than is due to their actual solidity. The experiment is certainly a beautiful one. Very respectfully, yours, &c.,

JOHN C. TRAUTWINE.

Knoxville, Tennessee, June 12, 1839.

Bibliographical Notices.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

FOULSTON'S *Public Buildings in the West of England.*

The author of this work, in his address to the public, only claims regard for the construction and adaptation of the classical forms of architecture to the buildings which he has rendered suitable for modern purposes, and very properly declines any merit in the originality of his designs.

His taste for Grecian forms, exhibited particularly in his buildings of the Royal Assembly Rooms and Theatre at Plymouth, wherein the Doric Portico at Athens, the Ionic of Illyssus, and the Corinthian of Lysicrates, are introduced, is well and skilfully managed, but the author can scarcely be allowed the liberty he has taken in varying the proportions, and admixing, in his adaptations, the prominent features of these sacred edifices. His example of the *Doric Portico* is *too robust*—the columns are at least *one diameter too low*, and the assemblage of windows and doors of the façade of the cell is entirely inconsistent and heterogeneous. The bases of the columns of the *Ionic of the Illyssus belong to the Corinthian of Lysicrates;*—and the author's restoration of the *Cyma* is novel, but we may venture to inform him that a repetition of the members of the level corona, in this example, could never have belonged to the original cornice. The *Corinthian of Lysicrates* is tastefully and prettily arranged in the ball room.

The designs of *St. Andrew's Chapel* are fantastically Grecian and Romanised:—there is an evident struggle with the various parts of this composition which shall be most prominent, and the perilous situation of the sounding board over the pulpit, is much more certain than that of the galleries, which are supported, whimsically enough, by the slender stalks of the Italian candelabra.

The author solicits attention to the distinctive peculiarities of his designs for the Cornwall Lunatic Asylum and Bristol Gaol. These designs are similar in point of ground plan arrangement, and possess much more merit in the details of their construction than in any other distinctive mark. The peculiarities of the general designs are in every respect like those of the Eastern Penitentiary of Pennsylvania, by Mr. Haviland, but not so extensively or perfectly arranged as in this building.

The author's impression for producing a picturesque effect by "*combining in one view*," the different orders and styles of architecture, which, as he says, *has not been before attempted*, is, to say the least, a very doubtful one, even according to his own showing. We would apprise him, however, that the idea of congregating the orders of architecture *in one group* is not new, but has been carried out practically, and, as we think, with an unhappy effect, some 20 years ago, by Mr. Jefferson in his collegiate buildings of the University of Virginia.

The work before us, however, contains very many chaste and graceful outlines, extracted and compiled from classical examples, together with some practical information given in the "*details at large*," which cannot but be of essential service to the young student of architecture.

The Builder's Port Folio of Street Architecture. By J. Collis.

We have examined this work, which, according to the title, consists of "*a series of original designs for fronts of houses of all classes.*" In the composition of these designs, we recognise nothing but that sort of originality which belongs to the depraved state of the architecture of Regent street, in London.

It is to be regretted, that in this composition the rage for the whimsical and fashionable profusion of ornament, should not be confined within doors, and not worn out on the street.

We would, if we could, say something in praise of this work, but we are at a loss in any attempt which might be made to excuse the fickle and uncontrolled range of the author's genius;—we are also at a loss to know why *street architecture* should differ from any other class of buildings that should not be submitted to the settled rules and proportions as well as all objects within the range of the builder's art.

Franklin Institute.

Conversation Meeting.—Dr. Hare's new Eudiometer.

At a Conversation Meeting of the Institute, held May 23d, 1839, Dr. Hare exhibited an improved aqueous, sliding-rod, hydro-oxygen Eudiometer, and stated that this instrument enabled him to analyse the air accurately within thirty seconds. Being, however, made to be used with water, accurate results could not be obtained by it when carbonic acid was one of the products, of which an accurate measurement would be necessary. It would of course be impossible to ascertain how far an absorption of this gas by water might add to the absorption resulting from the combustion and consequent condensation of hydrogen. Hence, in order to analyze gaseous carburets, another eudiometrical instrument had been constructed many years ago, in which mercury was the confining liquid. The mercurial sliding-rod eudiometer, now laid before the Institute, was an improved modification of that instrument. The pressure within the receiver of the apparatus in question being varied, (by pushing in or pulling out the rod through a collet of leathers, or stuffing box,) a communication was successively made, by means of cocks, with a reservoir of the gas to be analyzed, a reservoir of oxygen, and with a receptacle of carbonic acid: an appeal was made intermediately, in each case, to a mercurial glass syphon gauge, in order to bring the density, at the time of admeasurement, to the atmospheric standard. The ignition of the gaseous mixture was effected by means of the discharge of a calorimotor through a platina wire.

These preliminary explanations being made, the process for analyzing the carburetted hydrogen furnished by the Gas Light Company, was then performed by Dr. Hare's skilful and intelligent assistant, Mr. J. Bishop.

The following results were obtained, agreeably to several experiments in which the condensation and absorption were the same.

The oxygen employed having been first analyzed, by igniting it with three volumes of hydrogen, was found to contain four per cent. of impurity.

The gas exploded with the oxygen imparted to it, one measure of impurity for every 20 measures employed.

Hence, 20 measures being assumed as representing one volume, in order to have that quantity of pure gas, 21 measures were taken into the eudiometrical receiver, and were mingled and ignited with seventy-five measures of oxygen.

A condensation of thirty-five measures was found to ensue—one volume, or twenty measures, being attributable to the disappearance of the gas—since by its conversion into carbonic acid, oxygen undergoes no change of volume. Fifteen measures out of the thirty-five were to be ascribed to the oxygen consumed by hydrogen. But fifteen measures of oxygen require thirty of hydrogen, equal to a volume and a half; and thus it appeared that this last mentioned quantity of the last mentioned gas existed in the volume of gas subjected to analysis.

The residue, after being well washed with ammonia, was found to have lost fifteen measures, which, containing, agreeably to the known composition of carbonic acid, a like volume of carbon, represents the quantity of this element in the gaseous volume subjected to examination.

It follows, that there are three-fourths of a volume of carbon, and one and a half of hydrogen, condensed into one volume of the gas; so that in four cubic feet, there are three cubic feet of carbon, and six of hydrogen.

The gas obtained by passing the vapour of alcohol through a porcelain tube, has been found, by Dr. Hare, to contain a volume of carbon and a volume of hydrogen condensed into one volume. That obtained from the same liquid by sulphuric acid, usually known as olifiant gas, and with which the former has been compounded, contains two of carbon and two of hydrogen in one volume, as is generally received.

The gas light gas therefore contains twice as much hydrogen in proportion to its carbon, as those above described, and this might have been inferred from its being sufficiently buoyant for balloons, agreeably to Mr. Wise's æronautical experience. As the excess of hydrogen tends to lessen the liability to smoke, it is presumed that the gas, as constituted, may be preferable, for the purpose of illumination, to such as contain a greater proportion of carbon.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Richards' Process for the Manufacture of White Lead.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination a process for Manufacturing White Lead, invented by Mr. Richards, of Philadelphia, Report:—

That the extensive employment of white lead in the arts, and the well established deficiencies in all the processes hitherto adopted for its manufacture, induced them to institute a more critical examination of the process proposed by Mr. Richards, to supersede the method ordinarily pursued.

According to this process, the necessary apparatus consists of one chamber within another, the inner or lead chamber being tiled on its inner side, and completely surrounded by a twelve inch bank of tan on the sides, floor and roof, between which and the outer chamber, steam is allowed to circulate to maintain the temperature of the lead chamber at an elevated point. The sheets of lead are rolled up in the ordinary manner, flattened at one end, and set upright on the other on floors or shelves. A trough crossing the centre of the floor of the inner chamber, contains the vinegar, and may be said to have a double bottom, from small openings on either side of which air and carbonic acid are forced into the chamber. A similar hollow beam crosses the roof, permitting the entrance of steam from small lateral openings. For the first twelve hours after setting the lead, steam is allowed to enter, mingled with a small quantity of air, giving the lead a greyish white surface, while the mass remains unaltered. Acetic acid is now introduced into the trough, and steam and air continued for three days. During the following sixteen days, vinegar is still added, till the whole has amounted to one pint for three pounds of lead; and at the same time the steam is continued, while air and carbonic acid are forced into the apartment, the latter being generated by the combustion of coke. After these operations, the surface of the lead is greyish white and somewhat hard, the interior of the sheet containing, still, metallic lead. Up to this point, a period of twenty days, the temperature has been maintained at 120° Fahr., but during the remainder of the process, it should not be higher than 80° to 90° Fahr. During the remaining 15 days, equal volumes of air and carbonic acid are forced in, and a small quantity of steam admitted. The whole process, therefore, requires thirty-five days for its completion, when, if it has been well conducted, the surface of the lead will be covered with minute blisters, otherwise large scales of a white compound, probably an acetate, stand off from the surface of the metal.

It is generally acknowledged by those who have investigated the manufacture of white lead by acetic acid, that the theoretic character of the process is involved in much obscurity. The experience in Europe, as deduced from direct experiment, has been that the entrance of atmospheric air tends to darken the colour of the resulting white lead, but Mr. Richards asserts that he cannot succeed without it; and yet it is difficult to explain its action, excepting by its assisting in the oxidation of the metal. If oxidation proceed from the vapour of water or vinegar, we must suppose the disengagement of hydrogen, or carburetted hydrogen, an evolution that actually takes place at times in the dung process, and converts oxide of lead, on the external surface of the pots, to a metallic state. But we cannot suppose the quantity of these gases to be great, since the above result is only observed at intervals, when the process is not altogether successful. Now, as we know that a subcarbonated oxide of lead may be formed by the simple action of air and water or steam, which is the first step in Mr. Richards' process, and since we know that these bodies must be present, to a certain extent, in all methods for manufacturing white lead, we need not resort to acetic acid alone for the requisite oxygen, as is frequently done in the theories that have been advanced on this subject. Nor can we suppose, with any more reason, that carbonic acid arises from the vinegar alone, or in great quantity, and we have moreover abundant evidence to show the necessity of introducing carbonic acid generated from some other source. We are farther aware, from experience, that carbonic acid, air and water, will produce white lead, but that the combination of acetic acid with the water expedites the operation, with the production of a much superior article. From these premises, therefore, we draw the conclusion that the lead becomes oxidized chiefly from air and water, and only in part from the vinegar; that it then combines with free carbonic acid; and that the water, or its vapour, acts in part by keeping the substance formed in a softer state, thereby forwarding action on the remainder. But we may farther ascribe another and important action to the vinegar, by supposing it to combine with the oxide of lead, which has arisen in the manner above stated, constituting an acetate of lead, which is simultaneously decomposed by carbonic acid, in a manner similar to the French method of precipitating a subacetate, by passing carbonic acid gas through its solution. It is true, that in this latter case, a subcarbonate is formed from the subacetate, but if a subacetate be formed in the common process, it may be converted into the neutral carbonate, or common white lead, from the excess of carbonic acid present, and the length of time it remains in contact with it in a moist state,—or carbonic acid may have the power of decomposing a neutral acetate at the moment of its formation, thus producing a neutral carbonate. These theoretic views relative to the manufacture of white lead, are offered by the committee, in the hope that they may lead to a closer investigation of the subject, which may result in much practical benefit to the community.

The ordinary process for white lead by means of manure beds, is attended by many disadvantages—the breakage of the pots—the difficulty of setting them well by workmen—the amount of uncorroded lead remaining,—to which we may farther add, the greater or less uncertainty of the amount of heat and of carbonic acid, excepting after lengthened practical experience. The method consists in the evolution of carbonic acid by the putrefactive fermentation of organic matter, and in the simultaneous generation of heat, which vapourises acetic acid and water, and promotes chemical action. Whether it will be superseded by the process for passing these vapours into a chamber heated by steam, must be determined by a comparison of results. The white lead in either case, appears to be of equal quality, and with an increase of twenty-five per cent. on the metallic lead employed. By the dung process, the metallic matter remaining amounts to ten per cent. when well performed, and averages fifteen per cent., excepting the *failings*, which are converted into litharge and red lead. Mr. Richards states that his remainder does not exceed ten per cent. On this subject, however, it may be remarked, that where the lead is well *set* in the common method, it may be corroded to a considerable depth, for the committee have obtained specimens of white lead nearly half an inch in thickness, made by Mr. J. P. Wetherill, by setting a solid pig of lead in the dung bed. The committee have seen a comparative estimate of expenses, which leaves a balance in favour of the newer processes, but they believe that such an estimate cannot determine the relative values of the two, and that the execution of the new method on a large scale can only prove its superiority to that so long employed with success. In fact, Mr. Richards' mode of manufacture differs from the other, not by a difference of principles, but by a novel application of them. It has a decided superiority in point of neatness, and would also have in regard to accuracy, if the relative action of the agents were sufficiently understood, for we may introduce given quantities of each into the lead chamber, and maintain it at a given temperature. Indeed, it is the latter circumstance on which he chiefly relies for successful practice, and in which his process differs from others resembling it in other respects; and the committee deem his arrangement of heating by steam, convenient and manageable, although they are incapable of judging of its expense.

By order of the Committee.

William Hamilton, Actuary.

March 14, 1839.

Report on Ridgway's Improved Transit Theodolite.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an improved Transit Theodolite, invented by Thomas S. Ridgway, jr., of Pottsville, Penn., Report:—

That the improvement consists in the addition of two graduated plates, varying in size, to the transit theodolite, which are placed parallel to the line of the axis, and between it and the telescope; the larger plate is permanently attached to the axis, and that portion of its surface which projects beyond the upper and smaller plate, is so attached to the telescope, as to admit (in case of accident) of adjusting the line of collimation at right angles with the horizontal or bearing axis, when zero on the vernier of the upper plate coincides with 90° on the lower. The telescope revolves on an axis passing through the centre of the plates, and of the bearing axis at right angles, confining the parts in their proper position with regard to each other, by means of a tightening screw. By this arrangement, any plane in which the telescope is made to revolve, may be accurately defined at any inclination with the horizon. A screw is placed under the plates, which, by clamping them together, reduces this instrument to the condition of the common theodolite.

Mr. Ridgway states that he has used an instrument of the above construction for upwards of twelve months, and found it to answer the purpose intended. He suggested, as a variation in form, to affix a vertical arc beneath the graduated plates of the original instrument; but the committee think that the awkwardness of the instrument, and the uselessness of the needle when inclined to the horizon, are serious objections to this arrangement.

The great utility of this improvement is principally confined to mining operations, more particularly in tracing inclined coal strata; to effect this, the course and inclination, or dip, of a vein, is first taken by means of a drift or gaugeway; the instrument is then placed on the outcrop of the vein, and set to this course and inclination. The telescope being placed in the direction of the stratum, any angle may be taken by means of the additional plates, thus pointing out the crop in elevation or depression, without resorting to the usual tedious method of calculations from levels.

It was suggested, that no means being supplied for readjusting the parallism of the plates with the line of collimation, would be an objection to the instrument, but when it is considered that a slight variation in the adjustment would not materially affect the correctness of the observation, and also, that any accident to the plate would equally require the skill of the workman to repair it, as if it had occurred to any other part of the instrument, the committee are of opinion that the weight of that objection will be removed.

All the adjustments of the common transit theodolite can be made with equal ease and certainty on this instrument by use of the screw before mentioned attached to the plate.

The committee consider this instrument as well calculated for the purpose intended, and a decided improvement of the methods at present adopted to obtain the same results. The principle of the improvement is, that whereas the common instrument, in revolving, describes a cone, of which the bearing point of the telescope is the apex, it is now made to revolve in the plane of its inclination, whatever that may be.

By order of the Committee.

William Hamilton, Actuary.

June 13th, 1839.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1838,

With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Calico Printing Machine*; Alden Sibley, Pawtucket, Bristol county, Massachusetts, July 9.

This patent describes and represents the particular arrangement of the furnishing roll, the colour box, the doctor, and the parts appended thereto, and claims this peculiar arrangement; the object and advantages are not distinctly set forth.

2. For an improvement in the manner of constructing *Steam Engines;* Nathaniel Bosworth, city of Philadelphia, July 9.

The patentee says: "my first improvement consists in the manner in which I construct and set the boiler, or boilers, and connect them with the pipes for the conveyance of steam, and the auxiliary parts of the engine. The boilers which I employ are of the cylindrical kind, and they are to be so set that they may be completely surrounded by the flame and heated air from the fire, and have their whole surface, therefore, converted into a fire surface, instead of exposing one-half only of the boiler to the direct action of heat, as is usually the case. These boilers, as they are to be entirely surrounded by the fire, are to be kept completely full of water, and are not subject, therefore, to burn out. They are to be so set as to form a considerable angle with the horizon, rising from their front towards their back ends about one inch in a foot, by which elevation the steam will be caused to escape readily from the boiler into the steam chamber, or receiver, at its upper end." The particular manner of carrying this plan into effect is represented in the drawings.

"The steam cylinder, with its stuffing box, and piston, has nothing in it peculiar, excepting the construction of the piston, which is made of metal, in one piece, and without packing; it may be formed of hard cast iron, or of cast steel, and must be finished perfectly true and smooth. Its diameter is to be such that when its temperature is raised one hundred degrees above that of the cylinder, it will still pass through it readily, but leaving no sensible space between the two. When of the same temperature with the cylinder, it will of course pass through it loosely. Up to a diameter of four inches, I think it best to have the piston perfectly solid; but if above this size, it may be hollow, for the purpose of decreasing its weight.

"Such a piston I have found to work without any apparent friction, beyond that which necessarily exists in the passing of the piston rod through the stuffing box; and the most careful observation leads to the conclusion, that there is not any loss of steam between the piston and the cylinder; and if there is any, it has been practically proved to be so small in quantity as to be more than counterbalanced by the decreased friction, and by the other advantages resulting from the improved construction of the engine."

The valve is constructed with reference to a peculiar proportion of its parts, which is illustrated by a diagram; in its general construction it is nearly like some others; its peculiarities we cannot conveniently discuss in the space allotted to our animadversions. It is calculated to cut off at such part of the stroke as may be required.

To indicate the quantity of water in the boiler, a glass tube is used, as in some other machines, its upper end being connected, by a pipe, with the steam chamber, and its lower end with the lower part of the boiler. It is placed at a distance of six feet from the boiler, and from this circumstance, and the arrangement and construction of the tubes, it will always remain cool, whilst it may be so situated as to secure it from the liability to be broken by accident.

"In my improvements, I have had in view, mainly, to attain a higher degree of speed than has hitherto been thought eligible in the reciprocating engine. I have succeeded, in practice, in working the piston of my engine at a speed of upwards of two thousand feet per minute, and have thus produced effects at least five fold greater than have heretofore been produced by engines of the same weight. I am aware that I cannot claim the increased speed of which my engines admit, in the abstract, but I do claim it in combination with, and as resulting from, the manner in which I have constructed my engines, and especially from the peculiar construction of my piston, which moves, as I verily believe, absolutely without friction.

"I claim, therefore, the general combination and arrangement of the above described engine, taken as a whole, and as distinguished from other engines by appropriate characteristics. I claim the within described mode of constructing and setting cylindrical boilers. I claim the constructing of a metallic piston to move without friction in the manner set forth. I do not claim to be the first to have used a solid metallic piston, but I do claim to be the first who has used it so as to pass through the cylinder without friction, having been the first to ascertain that this might be done without a waste of steam. I claim the manner of constructing and using the receiver, where two or more boilers are employed, as herein fully made known. I claim the manner in which I have constructed my indicator, and connected and combined the same with the boiler, substantially as described. Lastly, I claim the particular construction of the slide valve for cutting off the steam at any designated part of the stroke of the piston; this result being obtained by the particular proportion of its parts, without any greater complexity of construction than in the ordinary whole stroke valve."

We have made large extracts from the specification of this patent, because there are some things in it which are interesting, and well calculated to arrest attention. Whether the experiments which were instituted on a large scale have been productive of new and useful results, we have not been informed, and are apprehensive, therefore, that such has not been the case.

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3. For an improved *Railway Cooking Stove;* Isaac B. Bucklin, West Troy, Albany county, New York, July 9.

"The stove is so constructed that the part which contains the fuel is movable on rollers, and may be made to slide under that portion of it which contains the oven; thus increasing or decreasing the size of the whole according to the use intended to be made of it."

The oven part of this stove is elevated upon legs, and the part which contains the furnace is made to slide under the oven, being guided upon ways, and moving upon rollers. The top of the furnace part is flat, and may have four boiler holes, all of which may be used when drawn out from under the oven; but when slid in, two of the boiler holes are out of use. The back portion of the top plate, having in it the two boiler holes, slides upon ledges, to adapt it to the flue which surrounds the oven, whether in use for the whole, or a part only, of the boilers. A movable flue, or funnel, fits into the front flue of the oven, its lower edges bearing upon the top plate of the sliding part, to make a close joint, and yet admit of free motion. The claim is to "the manner of combining the furnace, with its boiler holes, constituting, by itself, a complete cooking stove, but without an oven, with the part containing the oven, substantially in the manner and for the purpose above described, including, in this claim, the particular manner of adapting the sliding plate and the movable flue to the purposes they are intended respectively to accomplish."

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4. For *Increasing the strength of Wrought Iron and Steel, and of Articles formed of said Materials;* Walter R. Johnson, city of Philadelphia, July 9.

(The Specification will be published in our next number.)

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5. For *Forming and Stretching Horse Collars;* Henry Barton, West Carlisle, Coshocton county, Ohio, July 9.

Several machines have been patented for the above purpose, and in most instances the patents have been obtained for trifling variations in the stretching apparatus, the same end being attained by them, by different modes. Perhaps that before us may be better than its predecessors, but as but few of our readers will feel interested in discussing this point, we proceed to the next patent.

6. For *Elliptic Steel Springs for Coaches, &c.;* Melzer Tuells, Penn-Yan, Yates county, New York, July 9.

The nature of this improvement is stated to be the making the ends of the springs whole, and not with a joint there, according to the usual manner of making elliptic springs, so as to obtain the power of the springs at the ends. And, for the purpose of giving strength to the springs, one or more leaves are to be added at the ends. The claim is to this mode of construction.

7. For a *Machine for Boring out the Grooves on the inside of the Flyers of Double Speeders;* James S. Brown, Pawtucket, Bristol county, Rhode Island, July 9.

This is a very ingeniously contrived machine for cutting the cylindrical grooves on the insides of the flyers, which are cast solid. The cutter is a grooved cherry, like that employed for making bullet moulds; and the machine is so constructed as to hold the flyer and carry it regularly against the revolving cutter until the operation is completed. The claim is to "the cutting of the groove by revolving cutters against which the flyer is borne and moved by a revolving shaft, guide groove, pinion, and curved rack, with the respective parts combined and operating together in the manner described."

Such a machine is too complex for clear verbal description; we believe, however, that the one under consideration is as simple as the nature of the duty which it has to perform will admit, and we have no doubt of its perfect efficiency.

8. For *Cutting the Threads on Wood and other Screws;* James & Thomas Keane, Haverstraw, Rockland county, New York, July 9.

The machinery which forms the subject of this patent is represented in the drawing by twenty-one separate figures, which we cannot analyze. The main feature of novelty is the manner of forming the cutters for making the threads, and this part is in some respects similar to that employed by Mr. Sellick in his screw machine; that is, the cutting is effected by rotary wheels, with the worm, or thread, cut on their peripheries, so as to operate like the milling tool used to ornament turned work on the lathe, or jewellers' settings. These wheels are so constructed as to admit of their being ground when their cutting edges become dull. They are for this purpose, divided so as to form two faces. The claims are to "the mode of forming the rotary chaser wheels, and mounting them on adjustable carriages, and forming the said wheels so that they may be ground or sharpened on the face, so as to maintain a regular and equal cutting edge, as set forth; also the formation of said chaser wheel irrespective of any mode of mounting the same for use; and likewise the several modes of mounting and using said wheels, in combination with other mechanical means and appliances, already well known."

9. For a *Churn*; Daniel Osgood, jr., Blue Hill, Hancock county, Maine, July 9.

We are told that "this improvement consists in the machinery by which the dasher of the common hand churn is made to move up and down by the gravity of the machine and the cream. It is so constructed that the power in its operation, compared with the common churn, is nearly in proportion to the power required to draw a pendulum in its lateral motion compared with that of raising its weight."

Two common upright churns are to be placed upon a swinging platform, hung in a frame, and these are to be swung backward and forward by a rod attached to the platform, which is suspended by two side pieces within the stationary frame of the machine, through each of which joint pins pass. The upper ends of these side pieces have teeth on them, which mash into teeth on a separate swing frame which is to work the dashers. There is considerable ingenuity shown in the structure, but we apprehend that the merit of the thing begins and ends there. In the preliminary explanation of the views of the inventor, there is an apparent intention of making gravity counteract itself, a thing which has often been attempted, but not hitherto accomplished.

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10. For an improvement in the construction of *Fire Arms;* Elijah Jaquith, Brattleboro', Wyndham county, Vermont, July 12.

This is another edition of the many chambered fire arms, in which there is a revolving cylinder of chambers, the axes of which are parallel with those of the barrel. The main feature of novelty is in making the axis of this cylinder hollow, and placing it so as to coincide with the sight of the gun, so that aim may be taken through it. The other appendages for revolving and holding the cylinder, &c. &c., do not require any particular notice. Most of the numerous modifications of the many chambered guns which have been patented, are to be learnt only from the files of the patent office, or in the resting, or rusting, places in which those which have been made are already deposited, after what can scarcely be called, even a brief, existence. What is the state of the one which is the subject of this article, we do not know.

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11. For an improvement in *Door Locks;* Daniel Ball, Kingsbury, Washington county, New York, July 12.

This lock is to be made in a manner which is intended to diminish its cost to a mere trifle, as it is proposed to cast the box, the bolt, and most of the parts of which it consists, so as to require no finishing, but to be put together as they are taken from the flask. There are not to be any springs used, the spring bolt being forced forward by a weighted lever.

It is proposed to make the bit of the key to slide back and forth in mortises in its shank, and to cause it to be guided, in its action upon the bolt, by an excentric ward, or wheel, cast upon the lock plate. This construction of the key is claimed; with respect to its novelty we have some doubt, and as regards its utility, our doubts are very strong.

"I claim the use of a sliding bit key to operate by means of eccentric wheels, as described. I likewise claim the causing of the bolt, usually called the spring bolt, to shoot forward without the aid of a spring, by means of a weighted lever, operating by its gravity, whatever shape or form it may be thought proper to give to such a lever."

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12. For an improvement in *Lamps;* John C. Fletcher, Springfield, Clark county, Ohio, July 12.

This patent is taken for an improvement on a lamp formerly patented by Mr. Fletcher; the improvement claimed is in "the construction of a fountain, or reservoir, at the top of the lamp, and the conductor, or conductors, as described."

13. For *Apparatus for Roasting Meat and other Articles;* Samuel Pierce, city of New York, July 12.

This apparatus is denominated the " manifold roaster, or planetarium stove," and the patentee says, "The main object of my improvement is to combine together a number of spits, or jacks, each of which is to sustain a joint of meat, a fowl, or other article to be roasted; and each of which spits is to be suspended by a hook over its appropriate dripping pan, the whole of which spits may be made to revolve simultaneously by wheel work, properly geared, either before an ordinary fire, or more perfectly by being placed around a stove constructed for that purpose; in which latter case the spits not only revolve on their own axes, but have an orbicular revolution round the stove. The effect of the heat is, in either case, to be promoted by means of reflectors. When the planetarium stove is complete, and in operation, its external appearance is that of an ordinary cylindrical stove of large diameter, the external cylinder being a case (usually made double) which surrounds the stove, and which also surrounds the system of spits which revolve round said stove."

"What I claim as my invention, and wish to secure by letters patent, is the construction of a cooking apparatus having any convenient number of spits suspended vertically and made to revolve simultaneously round their own axes and round a common centre, by suitably geared wheels; the whole constructed and operated upon substantially as described. I also claim the giving a simultaneous revolution to a number of such spits, combined with a reflector, placed before an open fire, in the manner or upon the principle herein set forth."

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14. For *Preparing Tannin, and Solutions of Tannin,* from astringent barks; Augustus J. Hayes, Roxbury, Norfolk county, Massachusetts, July 12.

(See Specification.)

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15. For apparatus for "*Floating and Raising Vessels, and other Bodies, in Water;*" Samuel Carson, Great Britain, July 12.

The floating, or raising, of vessels is to be effected by the aid of air-tight bags, which, of course, is not claimed as new, the improvement consisting in a mode of defending those bags from injury, and of advantageously accomplishing some other objects connected with their use, as will be seen by the following quotation:—

"What I claim as my invention, and desire to secure by letters patent, is the forming and applying an envelope for the air tight bags, made of woven fabric of sufficient strength to sustain the same, in the manner described, and, as a substitute for such woven material, in the employment, as set forth, of a series of staves, or narrow boards, or of iron, or other metal, to surround said bags. Secondly, I claim the mode described by me of applying a cover of leather to the air pumps to be employed in inflating the bags, constituting an improved packing for the purposes herein fully shown. Thirdly, I claim the apparatus consisting of the forceps and its appendages, as described, for the lowering down flexible air tight bags, or vessels; which apparatus is so arranged that the forceps may be made to take hold of any part of a cable, and be raised and lowered at pleasure from above."

16. For a *Horse Rake for Raking Hay;* William Buckminster, Framingham, Middlesex county, Massachusetts, July 12.

The patentee calls this a flexible hay rake; it is so called because the piece of timber in which the teeth are set has a hinge, or other joint, in its middle. Behind this there is to be a flexible or jointed back board, placed horizontally, and from six to ten inches wide. The intention of this arrangement is not set forth, but the claim is to "the joint in the rake, also the back board in combination, both as described."

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17. For an improvement in the mode of *Hanging a Scythe to the Snath*, and of fastening the tholes; Joseph & Erastus S. Clapp, Montague, Franklin county, Massachusetts, July 16.

Although it has been decided that there was novelty sufficient to justify the granting of a patent in the present case, and although we have no doubt that the plan may answer the intention very well, we shall not attempt to describe the "iron boxes aforesaid, made, constructed, and applied as aforesaid," which form the subject matter of the claim.

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18. For an improved *Machine for Shelling Corn*; Joseph W. Webb, Mount Morris, Livingston county, New York, July 16.

In this machine the corn is to be put into a hopper, and to pass thence through four feeding holes between a vertical revolving cylinder set with teeth, and four vertical angular troughs, borne up against the cylinder by means of springs. It is thence to fall upon an endless apron of slats, which carries off the cobs and allows the corn to fall through, and to be acted on by a fan and the other appendages of an ordinary cleaning apparatus; the claim is to this particular construction.

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19. For a *Machine for Planting Corn;* Elisha Bunce, Westford. Middlesex county, Massachusetts, July 16.

This machine for the making of a furrow, and dropping, and covering, seed corn in rows, is, in its general construction, so much like some others, that a general description of it would apply equally well to a number of the members of the same family. The claim is "the combination of the double plough, constructed as described, with the seed roller, coverers, &c., in their combination as described." This is rather a narrow claim, but it is certainly as broad as the invention.

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20. For *Applying, or Adapting, the Coiled, or Spiral, Spring to Carriages*; Joshua Jones, A. M. Eells, and Horace Griswold, Delaware county, New York, July 16.

"A spiral spring, similar in its construction to the main spring of a watch, enclosed in a barrel, or cylinder, of any convenient diameter, i fixed on an axis near the middle of the perch of the carriage. From the periphery of the barrel containing the spring, and from opposite sides thereof, two bands are extended, one passing to the front, and the other towards the rear of the carriage, each of which bands is attached to the ends of a lever passing downwards from a cross piece, or bar, extending across each end of the wagon above the axletree, and parallel with it. At each end of the cross pieces. or bars, is also a shorter lever, or arm, passing towards the middle of the carriage, in a direction at right angles (or nearly so) with the downward lever before mentioned. To these short levers, or arms, the carriage body, or box, is attached at each corner, by a connecting rod and shackles, or, if thought preferable, by thorough braces."

"On one end of the cylinder containing the spring is placed a ratchet wheel and catch designed for winding up the spring to any degree of tension that may be required for sustaining either a light or heavy burthen."

The claim is to "the combination of the mode of hanging the carriage body, by means of the axles, arms, downward levers, &c., with the spring or springs, constructed and operating substantially as herein described; and also in combination therewith, the mode of regulating the tension of the spring, or springs, as herein described."

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21. For *Facing Stone;* Daniel Bunnel, Xenia, Greene county, Ohio, July 16.

To what special purpose this machine is to be applied we are not told, excepting that it is to be used for facing stones; and this is to be effected by placing a number of stones on the ground, side by side, so as to form a circular horizontal pavement, having in the centre thereof a step to receive the gudgeon of an upright shaft. From this shaft arms are to extend out to a circular rim, of the diameter of the lower bed of stones. Within the spaces between the arms and rim, other stones are to be laid, and upon causing the shaft and its arms to revolve by horse or other power, and supplying water and sand, the facing is to be effected. The claim is to "the manner of constructing a facing wheel, divided by arms and braces into separate compartments for holding and carrying the stones by which the facing is to be effected, substantially as herein set forth."

The foregoing contains all the information afforded by the patentee. The apparatus bears a strong resemblance to such as has been in common use for grinding certain hard substances which are to be reduced to the state of an impalpable powder, and washed over, such as the silicious matter for earthenware, &c., the main difference being that in these the lower bed of stones is contained within a circular curb, which will hold water.

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22. For an improved *Boiler for Steam Engines;* Abram Van Order, Ithaca, Tompkins county, New York, July 17.

This boiler is denominated the "labyrinth steam boiler." Its exterior form is that of a vertical cylinder, or oval, having a door near its lower part, opening into the furnace, or fire chamber. From this proceeds a flat flue, for the passage of the heated air, which flue is coiled round spirally, and terminates in a vertical flue or chimney, which rises from the centre of the boiler. The claim made is to "the forming of the flue in a flattened scroll within the boiler, and combining it with the furnace and the other parts, in the manner set forth.

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23. For a *Door Spring*, for closing doors; William Wilson, Greenfield, Franklin county, Massachusetts, July 17.

An open, coiled, spiral, or helical, spring, of steel wire, is surrounded by a cylindrical case. One end of this spring is sustained against a standard placed upon the door frame, and the other end by a similar standard on the lock rail of the door. One end of the tube containing the spring must be open, that a piston which enters within the coils of the spring, and has a shoulder bearing on its end, may play within it. The rod sustaining the piston, and a projecting piece on the closed end of its case, must turn on the standards against which they bear.

The claim is to "the application of the spiral spring to the purpose aforesaid, in the manner aforesaid, and the combination of it with the cylinder, piston, rod, and standards, and the mode and manner of attaching it to, and detaching it from, the door."

24. For a *Machine for Cleaning Wheat and other Grain;* David H. Cole, Portland, Cumberland county, Maine, July 17.

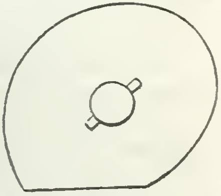
"The nature of my improvement consists in the compactness, combination, and general arrangement of the machinery so that the grain is carried down between two cylinders on a rotary track, or plane, by which circuitous route its stay is prolonged between rough iron, until the smut and other foul matter is broken to dust, and the cleaning accomplished without the loss or waste of grain."

The description of this machine is of considerable length, referring to the respective parts in the drawings, without which their particular form and arrangement cannot be made known. The claim is as follows:

"The particular manner of making and arranging the circular inclined plane between the cylinders, and the manner of carrying the grain downwards on said plane, by the combined power of wind and inclination; and, in connexion with this, the springs made in the circle which admit and discharge the grain; the bevils on the circles and inner cylinder which give the grain a direction from the joints towards the plane above, and the outlet below; the manner of connecting the sieves and fans, resting the arms of the sieve boxes on the shafts of the fans, by which both receive motion from the same pulley."

25. For an improvement in *Gun Carriages, for Naval and other Purposes;* William Smith, Washington, Mason county, Kentucky, July 19.

"The distinguishing character of this improvement consists in making about four-fifths of the periphery of each truck, or wheel, of the gun carriage, the figure of a section of a spiral curve, and the other fifth nearly flat, instead of a circle, for the purpose of retarding the motion of a carriage, as the gun recoils at discharging, and thus to prevent the breaking of the breeching, which often takes place when the trunks are made round." The sketch in the margin will give an idea of the intended form of the wheels.



To aid in training the gun for firing forward or abaft, anti-friction rollers are to be placed on the middle of the flat side of the periphery of the wheel, so that it may be moved laterally with but little friction on the deck. The claim is to "the construction of the trucks."

26. For improvements in the *Plating Mill for Manufacturing Spoons;* Sanford Boon, Hamilton, Madison county, New York, July 19.

The claim made is to "the combination of the skeleton plate, gauge, bar, and rollers, in the manner set forth." Two rollers are to be used for plating, which are barrel shaped, and which are to vary in their diameters, or convexity, as to give the varied thickness required in the different parts of a spoon, one of these rollers being changed to adapt them to spoons differing in size. The metal is to be passed between these rollers cross-way of the bowl of the spoon, and for this purpose, one of the cheeks of the frame in which they run, called the skeleton plate, has an opening, or long slot in it, for inserting the metal to be rolled. A bar of metal extends along the middle of said slot, or opening, to serve as a gauge or rest bar for the handle part of the spoon to rest on.

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27. For an improvement in manufacturing *Gum Elastic Shoes;* Charles Goodyear, Roxbury, Norfolk county, Massachusetts, July 24. (See specification.)

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28. For *Propelling Boats on Canals, &c., by the action of Air;* James Black, Orangeville, Columbia county, Pennsylvania, July 24.

The claim under this patent is to "the peculiar construction of the tangential outlets in the circumference of the circular case, with the inclined or curved buckets therein, for directing the air put in motion by the revolving fan, and directed towards the stern of the boat, whilst the boat is propelled in a contrary direction to said escape of air."

It would be a total waste of time and types to present our readers with any description of the apparatus here proposed to be employed. The attempt to propel a vessel by forcing air from a fan wheel is too absurd to demand refutation, and would not enter the mind of any one at all acquainted with the mechanics of fluids, excepting such an acquaintance was made in the form of "the baseless fabric of a vision."

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29. For machinery for "*Double Twist Screw Augers;*" Ezra L. Hommedieu & Richard N. Watrous, Chester, Middlesex county, Connecticut, July 24.

"The object of our invention is to form the twist of the auger by machinery applied to that object; and the lip with the centre worm, or pintle, by swaging in dies formed for that purpose." The apparatus, as represented in the drawings, appears to be well adapted to the attainment of the proposed end. The claim affords no information concerning the plan, nor is it one of those things of which a description would be of much general interest.

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30. For an improved *Cooking Stove;* Garret G. Heermance, Poughkeepsie, Dutchess county, New York, July 24.

The claim is to the particular manner in which the oven of this stove is constructed, of which, judging from the model, we entertain a very favourable opinion. The right has passed into the hands of Mr. Jordan L. Mott, stove manufacturer, of New York, and we know that Mr. Mott has made some valuable improvements on it, combining the particular device patented with some others which he intends, at an early day, to make the subject of a patent; and we shall then present it with the engravings necessary to make the construction fully known.

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31. For an improvement in *Pumps;* Jesse Reed, Mansfield, Plymouth county, Massachusetts, July 24.

This may be an improvement in pumps, but we doubt it, although we believe that it possesses some claim to novelty. The chamber and piston ordinarily employed are dispensed with, a sort of open vase taking the place of the former, and a hinged lid within said vase performing the office of the latter. This vase part, or open vessel, may be about twelve inches high, and nine inches wide one way, and six inches the other; its outline, as represented, resembles that of an inverted bell. At the lower end of this vessel, there is a valve covering the supply pipe, which descends into the well; and at about one-third of the height of it from the bottom, there is a shutter, or door, called the valve plate, which is hinged to one side of the open vessel, and is leathered on the other three sides to operate as a piston. The brake, or pump handle, is screwed into the valve plate, whence it rises and is recurved over the edge of the vessel; in this valve plate there is a valve opening upwards. This is the whole construction of this pump, so far as novelty is concerned. The patentee observes, that "the facility with which the valves can be taken out, cleaned, and replaced, makes it valuable for vessels at sea."

32. For apparatus for assisting in the operation of *Catching Fish*; Amrah Tiffany, Gibson, Susquehannah county, Pennsylvania, July 26.

This is an apparatus to be fixed on the rail, or other part, of a fishing vessel, where the lines for letting out and drawing in the seine are to pass over. It is furnished with a friction roller and guides for the lines, and it may be attached by means of two screws, and removed at pleasure. The claim is to the manner of combining the respective parts.

33. For an improved process for *Manufacturing Sugar from Beets;* Joseph Hurd, jr., Boston, Massachusetts, July 26.

(See Specification.)

34. For a machine for *Cutting Beet Root* into slices, preparatory to the manufacturing sugar therefrom; Joseph Hurd, jr., Boston, Massachusetts, July 26.

This is a machine in which there are vibrating knives at the bottom of a hopper, so arranged as to cut the roots into thin slices; with these are connected a vibrating bottom, and clearing rods, the action of which is such as to cause the sliced beets, which have a tendency to adhere, to be delivered clear of the cutters, and the other parts of the machine. The description is accompanied by five figures representing the various parts.

35. For a *Thrashing Machine;* Ammi West, Greene, Kennebec county, Maine, July 26.

The description of this machine for thrashing, includes that of the apparatus by which it is to be turned, in this there are two treadles, upon which the operator is to stand, one foot upon each, and these, by means of ratchets and palls, are to drive the machine. This is rather worse than the ordinary treadmill. To the shaft of this driving apparatus is to be attached a spur wheel, which is to mash into a pinion upon the shaft of the thrashing wheel, which is not in the ordinary cylinder form, but is a flat disk having spring beaters working upon joints near its periphery, and these are to act upon the grain, which is fed to it from a trough standing parallel to the axis of the wheel, the heads of the grain being sustained upon a suitable bed.

Although a full description is given of the propelling apparatus, it has not found its way into, or rather, we suppose, it has been expunged from, the claim, leaving that to the "attaching the spring beaters on the face, and near the periphery of the wheel to stand alone."

36. For an improved *Spark Extinguisher;* William S. Montgomery, Baltimore, Maryland, July 28.

The claim is to "the separation of the smoke and sparks by a chambered receiver, into which the smoke and sparks are compelled to pass, and from which the sparks are driven into the ash pan; the whole constructed and operating as described."

To those cognizant of what has been done in the spark arresting way, the foregoing claim will do something more than excite a doubt of the successful operation of the machine. When "the sparks are driven into the ash-pan," there is but little prospect that the smoke and heated air, of which they were the companions, will be separated from them, and driven up the chimney, with unimpaired freedom and velocity. The form of the apparatus before us differs from that of its predecessors; but the principle upon which it is to operate, has been essayed, and has proved a failure in more than one instance.

The patentee states, the manner in which he effects his purpose "is to apply to the front of the engine a receiver equally divided by a partition for two-thirds of its depth, into the smaller chamber of which both smoke and sparks are forced to pass by a curved discharge pipe leading into it from the smoke box of the engine; the sparks being forced, by the exhaust steam, into a pipe that communicates with the ash pan, the smoke rising on the other side of the partition into the chamber of the receiver, and passing off into the chimney."

37. For an improved mode of *Raising Water;* David L. Myers and Samuel Myers, Christianburg, Montgomery county, Virginia, July 28.

This is a device by which it is intended to raise a part of the water from a spring, or running stream, to such height as may be necessary; effecting this by means of another portion of the water of said stream, or spring. A portion of the running water is to pass along a trough leading into a box at the end of a long lever; the water running into this box forces the lever down, and the other end being connected with the piston of a forcing pump, depresses it; the water is discharged from the box by the descent of the lever, which is then raised by a counter weight, and with it the piston of the pump ascends, and so on alternately.

Devices for the same purpose have been numerous, and some of them on a principle similar to that before us, and, at least, equally good; situations where such a contrivance is applicable are not numerous, and at all events, we much doubt the realizing of a fortune by this patent.

38. For a machine for *Jointing Staves for Barrels;* James Wyman, Boston, Massachusetts, July 28.

In this machine, the stave is to be held down by clamps upon a suitable bed, and two revolving shafts having an inclination corresponding with the slope of the joint, and carrying cutters like those used in Woodworth's planing machine, are moved along it by means of suitable guides. These shafts are hinged to a step at their lower ends, allowing their upper to recede from or approach towards each other. Their upper portions are acted upon by guide rails, causing them to open and close so as to form the bilge. The claim is to this arrangement.

39. For an improved *Water Wheel;* Samuel B. Howd, Geneva, Ontario county, New York, July 28.

This is another of the so-called reacting water wheels; the claim is to "the application of the water upon the outside of the wheel, and operating upon the principle of reaction, by discharging inwardly, with the spouts or shutes, giving the water a direction with the motion of the wheel, applied to a reaction wheel as aforesaid."

This wheel does not contain any thing to take it out of the family to which it belongs, and which, unfortunately, is not one of very high standing, although each of the children has been heralded as a prodigy at the time of its first appearance on the stage.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent granted to AUGUSTUS A. HAYES, *of Roxbury, in the county of Norfolk, and state of Massachusetts, for a Process of Extracting Tannin from Bark. July 12th,* 1838.

Be it known, that I have invented an improved process for preparing tannin, and solutions of tannin, from astringent barks, for the purpose of tanning hides and skins generally, of which the following is an exact description.

I place in suitable vessels, the contents of which can be heated by steam, or otherwise, the quantity, and kind, of bark to be operated upon, after it has been deprived of its out coat, or *ross*, and add hot or cold water sufficient to cover the bark. I then dissolve so much of the alkaline salts of either ammonia, potash, soda, or lithia, or of these alkalies in a pure state, as may be required to neutralize four-fifths of the acid naturally contained in these barks, (which quantity varies according to the season of cutting the barks) in one barrel of hot or cold water, and mix the alkaline solution so obtained, with the bark and water, by strong agitation. I allow this mixture to remain one hour, and after that time, heat the whole to nearly the boiling point of water, then withdraw the heating source, and allow the clear liquor to drain from the bark. I wash the bark which remains with the weak liquors which have been used for washing other portions of bark, and mix the liquor which drains from the bark with that previously obtained, so long as it is denser than water; what remains is used for washing the next quantity of bark. If I operate without applying heat to the mixture, I allow it to remain for twenty-four hours mixed, instead of one hour, and then proceed as above described.

The solution of oak or hemlock tannin thus obtained, may be used for tanning operations generally, or for concentration, by which the watery part is dissipated by heat, and the bulk and weight greatly reduced.

If I operate on 128 cubic feet, or 1122 lbs. avoirdupois, of dry hemlock bark, deprived of its outer coat, or ross, I use, and prefer, 11 lbs. of dry carbonate of soda, (called soda ash) or 16 lbs. of carbonate of potash, (called pearlash) although the alkaline bases of these salts, and other alkalies in equivalent proportions, will serve for neutralizing four-fifths of the acid naturally contained in that bark, and these are the mean quantities required. I then extract the tanning principle by the method described above, and if it is to be carried to distant parts, I concentrate it by boiling it in vessels of lead, tin, or copper, heated below 300° Fahr., until it is reduced to the form of a consistent paste.

I claim as my own unaided invention, the process above set forth, by which the alkalies, ammonia, soda, potash, and lithia, or the alkaline salts of these bases, are used for neutralizing the acids existing in astringent barks, and extracting, by their means, the tanning principle, in a state better fitted for use than by any other known process.

AUGUSTUS A. HAYES.

Specification of a Patent for an Improvement in the Manufacture of Gum Elastic Shoes. Granted to CHARLES GOODYEAR, *Roxbury, Norfolk county, Massachusetts, July 24th,* 1838.

The gum, having been dissolved or not, is, as is usual for other purposes, formed into thin sheets, varying in thickness, as may be required for various kinds of shoes. Two sheets, of about an equal thickness and dimensions, are used for a shoe. The last on which the shoe is to be formed, is first covered with one of these sheets of gum cloth, cut in pieces; tape, thread, or other fibrous substances, which have been previously covered with a solution of gum elastic, are placed across the bottom, extending about half an inch up the sides of the shoe, as also at the toe and heel. These stays of any fibrous substance, are intended to strengthen, and also to prevent the shoe from cutting through upon the bottom and sides. They may be placed, or woven, at suitable distances from each other, say about half an inch, in various patterns, according to the fancy of the maker, and being disconnected, do not prevent the shoe from being sufficiently elastic; a heel piece is next placed to stiffen it, and the other sheet of gum, which forms the outside of the shoe, is then placed over the whole upon the last; the sole of the shoe is next added.

All the parts being in an adhesive state when used, are joined together. An elastic binding, formed of gum elastic and thread, or other fibrous substance, is then placed around the top, to prevent the shoe from tearing.

These shoes are afterwards tanned, or cured, according to a chemical process, as specified and patented by myself, the 17th day of June, 1837. These shoes, so constructed and tanned, as hereinbefore described, are preferable to the imported article, inasmuch as they are made to fit exactly, are not liable to damage or tear, and do not sweat the feet, as do other gum elastic shoes.

What I claim as my improvement, and desire to secure by letters patent, is the combination, in the manner above described, of gum elastic and any suitable fibrous substance, so arranged that the shoe may be strong, not liable to damage, and yet elastic and comfortable.

CHARLES GOODYEAR.

Specification of a Patent for Manufacturing Sugar from Beets. Granted to JOSEPH HURD, JR., *of the city of Boston, July 26th,* 1838.

To all whom it may concern: Be it known, that I, Joseph Hurd, jr., of Boston, in the state of Massachusetts, have invented an improved mode of manufacturing sugar from beets, by which the process is so much facilitated as to enable every cultivator to perform it in his own family, with great economy and efficiency; the apparatus employed not being costly in the first instance, and the operation being carried on, principally, by means of such utensils as every farmer already possesses.

The beets, after being taken from the ground, and freed from all extraneous matter, are to be cut into slices, the thickness of which should not much exceed the eighth of an inch. I have invented a machine for the purpose of performing this operation, which is more effective than any other with which I am acquainted, and for which I have obtained letters patent of the United States. The beets are to be taken out of the ground as soon as they are perfectly matured, and are to be then stored in a cellar, or other suitable place, as otherwise they rapidly undergo a change unfavourable to the production of sugar; they are to remain in this situation until the arrival of the time for slicing and drying them. The proper period for this operation is the earliest season of frost; as, in my process, they are to be exposed to a freezing temperature, so as to freeze and dry them in the air immediately after they are cut. This freezing is an essential point in my process; this, together with the dispensing with the use of lime, and the producing of sugar without molasses, may be denominated its characteristic features. To dry the beets after slicing them, they may be spread out upon laths, or upon netting, or in any other manner in which they will be most completely exposed to the frost, and to the wind; the desiccation, when sliced as above directed, requires but a short space of time, and is effected without injury to the saccharine principle. After being thus frozen and dried, the subsequent steps of the process may be performed at any time, as not the slightest injury will result from keeping the beets in a dry state for any length of time.

When it is desired to proceed to obtain the sugar from the beets immediately, they may be subjected to the freezing process only, then thawed, and submitted to pressure; they will then readily yield the greater part of their juice, which they would not have done if pressed prior to their being frozen. The pressed slices, with the residuum of the sugar contained in them, may afterwards be dried, and kept as food for cattle.

When the sugar is to be extracted from the dried beets, which may be done at any season, they are to be steeped in pure water, which will take up all the soluble matter, an effect consequent upon the change produced in the beet by freezing. The quantity of water need only be such as shall suffice to cover the beets, and may be about one-half of that which was lost in the process of drying. The soluble materials consist principally of the sugar, the mucilage, and a portion of colouring matter. To free the sugar from the mucilage and colouring matter, I generally acidulate the water before pouring it upon the dried beets, by adding to it a minute portion of sulphuric acid; the quantity of this cannot be easily designated, otherwise than by observing that it shall be no greater than shall suffice to render the acid taste just perceptible. Sometimes I add the water alone, and after allowing a sufficient length of time for it to take up all the soluble matter, which may be from three to four hours when cold water is used, but a much shorter period will suffice with hot water; I drain off, and press out the solution from the residual matter, and then add thereto the sulphuric acid, as before directed. In the former mode, but little of the mucilage and colouring matter is taken into solution; in the latter, they are precipitated, or so far disengaged from their combination with the sugar, that they separate in the form of scum, and are readily removed when the liquid is boiled.

The liquid thus prepared, is to be put into a boiler, and placed over a fire, a portion of the white of eggs, or other fining, being added. When brought to a boiling heat, a scum will rise, which is to be removed after damping, or taking the kettle from, the fire, which is to be repeated as long as any scum rises.

The next operation is to filter the liquor through animal charcoal, (ivory or bone black.) A stratum of two or three inches in thickness will suffice for every useful purpose, when the previous preparation has been used as above directed. The sirop will come through perfectly fine, and nearly as colourless as water; there will, however, be a very slight yellowish green tinge, resulting, apparently, from the presence of a peculiar principle in the beet; this material separates when crystallization takes place; although its quantity is minute, and its weight scarcely appreciable, it will, if left among the crystals, occasion an adhesiveness of the particles, and a tendency to deliquescence; it should therefore be got rid of, and this is easily effected. All that is necessary is to pour a quantity of white sirop upon the crystallized sugar after it has been pressed, so as to moisten it throughout, and then press it again. This operation requires but little time, and should be repeated until the sugar is fit to pack.

The evaporating of the water from the sugar, preparatory to its crystallization, may be in great part performed over an open fire without danger of injury; it may be completed by placing the evaporating pan in a vessel of water kept at about 150° of Fahrenheit's thermometer. When this is performed early in the season, or by taking beets which have been frozen and dried at the proper time, there will not be the smallest portion of molasses produced, the whole of the sugar being crystalizable. In very cold weather, a large part of the water may be removed in the form of ice, by allowing it to freeze, and much labour and fuel be thus saved.

When the clarified sirop is sufficiently concentrated, small brilliant crystals will appear upon the sides and bottom of the vessel, and a crust soon forms over the surface of the liquor; the crystals go on increasing in size, and that portion of the sirop from which the air is excluded continues in a perfectly clear and liquid state; but if the sirop be at this time stirred, it becomes opaque, and of milky whiteness; a deposition of fine white sugar then takes place, and whatever of impurity may have remained in the liquor will rise to the surface; this portion crystallizes more slowly than the other, but by drawing it off, and again exposing it to heat, it will readily form good sugar.

Having thus fully described the process which I have devised for the manufacturing of beet sugar, I do hereby declare, that what I claim as my invention, and desire to secure by letters patent, is the preparing of the beets for the subsequent steps of the process, by exposing them, in thin slices, to the action of frost, after which they may be directly thawed, and submitted to pressure; or they may be dried by a current of cold air, and treated in the manner set forth, at any convenient time; it being always observed, that when the process for the extraction of the sugar is commenced, it must be completed without delay, as upon this depends the ability to produce the sugar without molasses, and without the employment of lime to correct acidity.

JOSEPH HURD, JR.

ENGLISH PATENTS.

Specification of a Patent granted to THOMAS HANCOCK, *of the county of Middlesex, Patent Waterproof Cloth Manufacturer, for Improvements in the Method of Manufacturing or Preparing Caoutchouc, either alone or in combination with other Substances.*—Sealed January 23, 1838.

My improvements in the method of manufacturing caoutchouc consist in forming this substance into sheets, and into long uniform slips or threads, in the manner following:—I prepare the caoutchouc for forming these sheets in the manner fully described in the specification of a patent granted to me for an improvement or improvements in the process of rendering cloth and other fabrics partially, or entirely, impervious to air and water, by means of caoutchouc or India rubber, bearing date the 18th day of April, 1837, and to that specification I refer for the particulars of such process.

I will now describe the manner in which I form this prepared caoutchouc into sheets. I take linen, silk, cotton, or other suitable cloth, and saturate or fill the texture with common glue, size, gum, paste, or any other similar substance easily removable by water, and when dry, I pass this cloth through a calender, or otherwise smooth the surface of it more or less, as the case may require. I then spread the prepared caoutchouc upon this cloth, by means of a machine similar to that described in my said former specification, as suitable for this purpose. If one coating is not sufficient, I repeat the operation, and when the coating is dry, I immerse the whole in moderately warm water, and let it remain until the gum, or size, is sufficiently softened to allow the caoutchouc to be separated from the cloth. If the sheets are required of greater thickness than can be conveniently made by successive coatings upon one cloth, I spread the caoutchouc upon two cloths, and unite the two coated sides together before they are quite dry, and I then strip off the cloth from one side, and apply a third coating, which has been spread upon prepared cloth, in the manner before described, on that side, and continue to add fresh coatings in the same manner, until the required thickness is obtained. Instead of filling the cloth with gum, or size, one side of it may be covered with paper pasted on, and caoutchouc spread upon it, and the cloth and sheet separated by immersion in water as before stated. If it is desired to attach the sheets permanently to cloth leather, &c., I spread a coating or two of the well known common solution of caoutchouc upon it by way of cement, and when nearly dry, unite the sheets thereto by pressure, and then strip off the gummed cloth by immersion in water, as before described. Any suitable pattern, or graining, may be given to the sheets of caoutchouc by raising figures previously on the prepared cloth, either by embossing or otherwise. Colouring matter may be added to the caoutchouc in the manner described in the aforesaid specification, or the sheets may be coloured by laying on, with a brush, any of the common pigments, such as flake white, vermillion, lamp black, blue verditer, &c., mixed with a very thin solution of caoutchouc, composed of about ten ounces of manufactured caoutchouc to one gallon of rectified coal oil, or turpentine. The sheets may be printed with the same colours, by means of plates, type, blocks, or stencilling, in the manner commonly practised. I also form sheets to be used as tablets for writing or drawing on, with crayons, French chalk, &c., by adding pumice powder, fine emery, or other similar gritty substances, either in the manner described in my said former specification, with reference to colouring matters during the preparation of the caoutchouc, or by coatings of these substances mixed with a thin solution of caoutchouc after the sheets are made, as before described. I also form sheets from the original native and liquid caoutchouc, as imported from South America, by preparing the cloth with gum, or size, as before stated, and I find a convenient mode of doing this is, by attaching two of the gummed cloths together, by means of paste, or gum, and then immersing the cloths in the liquid caoutchouc, and allowing the superfluous liquid to run off. I then hang up the cloth to dry, and when dry, immerse it again in the contrary direction, and again allow it to dry, and continue the operation until the sheet has acquired the desired thickness; I then separate the cloth from it by immersion in water, in the manner before described. The edges must be trimmed, or cut off, if necessary, to allow the water to penetrate into the cloth. The surface of the cloth may be either plain or figured, as before described, and colouring matter, or emery, or pumice powder, introduced into the first or subsequent coatings. If the sheets are required to be only of a comparatively small size, or of particular shapes, I form the flat, or figured, surface upon which I make them, of plaster of Paris, and pour on the liquid caoutchouc. If required of considerable thickness, I find it best to pour on a thin coating first, and allow it to dry, and continue to do so until the desired thickness is obtained. If a very smooth surface is wished, I spread it upon plate glass. In some cases, I employ a raised edge of wood, or other material, as a guide to regulate the required thickness of the sheet, and to prevent the caoutchouc from spreading too far. I also find, for some purposes, that a coating of native liquid caoutchouc improves the sheets formed of manufactured caoutchouc first described; in such cases, I apply it either by dipping the sheets in the liquid, or spreading it on with a spatula, or other convenient instrument. I manufacture the long uniform slips, or threads, from the native liquid caoutchouc, upon cylinders of wood, or metal, by turning, or otherwise forming, a spiral groove, of the width and depth of the required slip, or thread. I fill this groove by immersing the cylinders in the liquid, and, with a straight piece of wood, or metal, clear the liquid from the projecting parts, and when dry, I immerse it again, and continue so to do until the groove is filled, when, by immersing the cylinder for some time in moderately warm water, the slip, or thread, of caoutchouc may be drawn off, and will be of the length and size of the spiral groove. I also follow the same process of coating a plain cylinder with the liquid until a uniform substance of the required thickness is obtained; the cylinder is then put into a machine attached to a screw motion, and the slips, or threads, cut, with a circular knife, to the required size. As this machine is well known to persons conversant with this manufacture, I need not further describe it. And lastly, I do further declare, that I do not, under the said first recited patent, claim as new the processes described by said former specification, nor the mixing of colouring matters with the caoutchouc, nor the common solution of caoutchouc as a cement, nor the use of calenders, or of any other machinery, matters, or things, that have been previously used or practised.

Rep. Pat. Inv.

Specification of a Patent granted to NATHANIEL WORSDELL, *of Liverpool, for Improvements in Apparatus to facilitate the conveyance of Mail Bags, and other Parcels, on Railways or Roads.*—Sealed January 4, 1838.

At present, in taking up or leaving mail bags, or other parcels, conveyed by railway or railroad carriages, it is necessary to stop the train of carriages, or so much to reduce the speed of the train, that the persons at the station may hand up the bags, and that the guard may deposit the bag, or bags, to be left, on the ground, or with a person placed to receive them. And according to both these means, much delay necessarily takes place in the conveyance of mail bags, as well as loss of time to the whole train. And further, when the speed is only reduced, (in place of stopping the whole train of carriages) the bags are liable to be missed by the guard, and such has often been the case, and the bags have fallen to the ground; and in addition to the delay caused by the stopping of the train, and backing the same to the spot where the bag had been left, or otherwise waiting until the same is brought to the train, the bag has, in some instances, been found to be materially injured, and cut, by the wheels passing over it. And from this reason, in case the stations were numerous along a line of railway, which it is very desirable should be the case, in order to give the utmost extent of quick communication, the time lost, even in diminishing speed to take up and put down letter bags, and again to get up the speed of the train, when compared with the whole running time of the train of carriages between two places, would be found to be a most serious loss of time, and will be found to offer almost a barrier to numerous stations being had on a line of railway, or railroad, for mail bags and for parcels. Now, my invention consists in applying mechanical means to railways, or railroads, and the carriages which run thereon, whereby mail bags may be taken and left at any determined places, or stations, with the greatest facility, without stopping or retarding the motion or speed of the train of carriages, and by such means the number of places for taking and leaving mail bags may be increased very materially, and the general system of conveyance of mail bags facilitated. And although I have here spoken of mail bags, I mean it also to apply to bags containing parcels, for it is better to put small parcels in bags.

The principle of action of the apparatus applied is such, that a bag containing letters, or parcels, being held in such a position as to be in the way of suitable means or instruments for taking the bag, and, on the other hand, where it is desirable to leave bags, there is connected with a carriage of the train, suitable apparatus or instruments to support the bag in a position to be intercepted by apparatus or instruments for taking the bag so placed. Now it will be evident that the apparatus in both cases may be varied as to its particular action or formation, to produce the desired effect, and yet remain in substance the same. I do not, therefore, confine my invention to the instruments here shewn, though I believe they are the most simple which can be employed, and the best for the purpose. In my arrangement, a bar is applied at the back of a railway carriage; this bar is capable of sliding to and from the carriage in staples, affixed to the back of the carriage, usually that carriage of a train of railway or railroad carriages called the mail, when the same is intended for mail bags; but it will be evident that the apparatus may be applied to other of the carriages, when intended for the delivery of parcels, and the apparatus for parcels may be separate from the apparatus for mails. A set screw, applied by the guard, (when he has slided the bar to its position) fixes the bar for the time, till it has taken up or left the bags held thereby. A prong projects from the bar, at right angles thereto, and is curved upwards, in order, when a mail bag has been taken by it, that the same may not fly off by any motion or swing, which may take place by the same being put suddenly into motion with the train of carriages. At each station, or place where it is desired to take or leave mail bags, there is to be an apparatus suitable for holding the bags, to be taken by the train of carriages when passing; and if bags are to be left at the same place, then there is to be fitted up suitable apparatus for receiving the bags which are carried by the bar, on the projecting prongs. The apparatus applied to the railway, or railroads, at the determined stations, or places, is similar to that applied to the railway or railroad carriage, and the apparatus is sustained by a post, or upright, on which may be placed a lamp.

Having thus explained the nature of the apparatus which I prefer for carrying out my invention, and which I have found fully to answer for taking and leaving mail bags and parcels when traveling at high speeds, I will describe the manner of using the same. The guard places the cord, strap, or chain, on to the prongs of the bar, or a number of bags may be strung on to a strap cord, or chain, or other convenient means or instrument, and together securely placed on the prongs; he then slides out the bar, and fastens it by the screw; it will consequently follow, that when the train of carriages passes the station or place where there is a suitable apparatus, the bag, or bags, on the bar will be taken by a prong, or other suitable instrument; and if it be desired that there should be a bag, or bags, taken by the train, as well as left at a station, then such bag, or bags, are to be supported by suitable means, such as the prongs, the post, and the prong of the bar, will take such bag, or bags; and it only remains for me to remark, that I lay no claim to any of the parts separately, nor to their use, for any other purpose than for carrying out my invention, which I declare to consist of the application of mechanical means, such as herein explained, to railways, or railroads, and carriages traveling thereon, for taking and leaving mail bags, and parcels, whereby much time will be saved, and certainty of action obtained, and whereby the conveyance of mail bags, and parcels, will be materially facilitated, as above described. Ibid.

Specification of a Patent granted to Charles Button, and Harrison Grey Dyar, *of the county of Middlesex, for Improvements in the Manufacture of White Lead.*—Sealed December 23, 1837.

We, the said Charles Button, and Harrison Grey Dyar, do hereby declare the nature of our said invention to consist, first, in purifying the gases, or vapours, arising from anthracite coal, or from stone or mineral coal, or from coke, so that either of these kinds of fuel may be used instead of charcoal, in the process of manufacturing carbonate of lead, the said purification being effected by a process of burning and of washing, hereinafter explained.

Secondly, in the use of basic nitrates of lead for producing carbonate of lead; and

Thirdly, in causing white lead to be made from litharge, massicott, or protoxide of lead, by boiling nitrate of lead stirred up with either of those substances, and exposing the mixture, while hot, to be acted upon by carbonic acid gas.

Now, whereas, we do not claim as our invention, or as any part thereof, any particular apparatus for generating carbonic acid gas, nor the particular means hereinbefore described, of introducing the same, when generated, into our solution, although we have shewn the best which we are at present acquainted with, for the purpose of obtaining those two objects; nor do we claim as our invention, or as any part thereof, any particular apparatus as necessary to be used, in order to obtain either the combustion or purification, aforesaid, of the vapours and gases arising from the fuel in the furnace. But we claim as our invention, first, the acting upon the vapours and gases arising from the fuel used in the furnace employed in the process of making white lead, in such manner (by burning and by washing the said vapours and gases in manner hereinbefore described,) whereby we destroy the impurities in the said vapours and gases which are injurious to the colour and quality of white lead, and are enabled to use that cheap kind of fuel, called anthracite, or stone coal, or mineral coal, or coke, in the said furnace, instead of charcoal, and also to use the carbonic acid gas obtained therefrom in the process of manufacturing white lead.

Secondly, the manufacturing white lead from compounds of nitric acid with oxide of lead, in which the quantity of oxide of lead bears a greater ratio to the nitric acid combined therewith, than the oxide of lead bears to the nitric acid in the ordinary nitrate of lead of commerce, and which nitrates we call, and are known by the name of, basic nitrates of lead, in the manner hereinbefore described; and

Thirdly, the making of white lead by uniting and acting upon, or mixing, litharge, massicott, or protoxide of lead, with nitrate of lead, (which uniting, and acting upon, or mixing, are best effected by boiling, as hereinbefore described, but may be obtained at less degree of temperature, though not so advantageously, without boiling,) and submitting the same, so mixed together, to the action of, or bringing the same, so mixed together, minutely into contact with, carbonic acid, in order to produce carbonate of lead, or, as it is usually called, white lead, and in such manner that the same nitrate of lead may be used over and over again many times, with fresh portions of litharge, massicott, or protoxide of lead, as hereinbefore described.

Ibid.

Progress of Practical and Theoretical Mechanics and Chemistry.

A Statistical View of the recent Progress and present Amount of Mining Industry in France; drawn from the Official Reports of the "Direction Générale des Ponts et Chaussées et des Mines." By G. R. Porter, Esq., F. R. S.

The law which gives authority to collect statistical details of the mining industry of France, was passed by the legislative chambers in April, 1833. The execution of the duties enjoined by that law, is entrusted to a public department known as the "Direction Générale des Ponts et Chaussées et des Mines," and placed under the ultimate control of the minister of commerce and of public works. Attached to this department is a staff of well instructed, able engineers, who make a personal inspection of every establishment connected with mining operations, and a report is carefully drawn up from materials supplied by these officers, and presented every year to the minister of public works. These reports present a most elaborate view of every branch of mineral industry in each department of the kingdom; and it may excite surprise on the part of an English audience, to learn that 85 out of the 86 departments into which France is divided, are, in some branch or other, interested in the inquiry; some of them, it is true, are so interested in only a trifling degree; but Gers is the only department which does not, in any way, add to the mineral wealth of France.

In the earlier stage of their labours, the inspecting engineers limited themselves to the collection of information concerning the actual condition of the establishments visited during the current year; but they have since obtained materials for comparing the annual progress of the most important branches, and have compiled and presented tabular statements of the quantity and value of mineral fuel, and of various metals produced in each year, from 1814 to 1836, inclusive. From these tables, the results of which will be given hereafter, it will be seen at what a rapid rate of increase the mineral resources of France have of late years been developed—a rate which may reasonably suggest the probability of its being in some part owing to the public attention having been drawn to the subject, and still more, to suggestions offered to the proprietors of works by accomplished engineers, at times when the works have been inspected. The increase in the value of the coal, iron, lead, antimony, copper, manganese, alum, and sulphate of iron, since the system of inspection was begun, has been from 105,750,995 fr. (£4,230,039,) in 1832, to 154,228,455 fr. (£6,169,138,) in 1836, or 45 per cent., as under,—

	1832.	1836.
	Francs.	Francs.
Coal, lignite, and anthracite	16,079,670	26,607,071
Iron and steel	87,312,994	124,384,616
Silver and lead	856,673	821,534
Antimony	71,233	305,032
Copper	247,680	196,924
Manganese	105,150	152,671
Alum and sulphate of iron	1,077,595	1,760,607
Total	105,750,995	154,228,455

The increase experienced in the same branches during the four years that preceded these inspections, viz. from 1828 to 1832, amounted to no more than 304,392 fr., or £12,175, while the increase experienced during an equal period under the system of inspection, viz. from 1832 to 1836, has been, as above stated, 48,477,460 fr., or £1,939,098.

Coal.—There are 46 coal fields (*bassins houillers*) from which that mineral is obtained in France. These coal fields are situated in the following departments, 30 in number, which are here arranged in the order of their productiveness, as shown by the quantities produced in 1835, and stated in English tons:—

	Tons.		Tons.
Loire	812,914	Haute Loire	28,883
Nord	531,605	Loire Inférieure	21,742
Saône et Loire	142,149	Tarn	18,420
Aveyron	119,152	Hérault	16,201
Gard	45,569	Haute Saône	16,128
Calvados	41,511	Allier	13,826
Nievre	30,162	Maine et Loire	11,556

Puy-de-Dôme	11,387	Vosges	1,356
Rhone	7,463	Dordogne	1,000
Mayenne	6,206	Haut Rhin	537
Ardeche	5,229	Vendée	504
Pas-de-Calais	3,736	Bas Rhin	177
Moselle	3,015	Cantal	177
Correze	1,763	Lot	60
Creuse	1,576	Aude	22

The coal mines in the department of the Loire are the most important, as well on account of the quality of their produce, as of the extent and geographical position of the field. This occupies the entire width of that narrow part of the district of Forez which separates the Loire from the Rhone, where these two rivers approach the nearest to each other. Being thus situated near two navigable rivers, the produce of the mines readily finds its way to Marseilles, Mulhausen, Paris, and Nantes; Lyons is supplied by means of the rail road between that city and St. Etienne. There are 45 separate mining establishments, which extend over an area of 42,038 English acres.

In the department du Nord, coal is raised by eight different establishments, from the coal field of Valenciennes, which is a prolongation of the great coal formation of Belgium. The produce is distributed by the Scheldt, the Scarpe, the canal of St. Quentin, the Oise, and the Seine, and is used in the department du Nord, in the Pas-de-Calais, and in Paris.

The department of the Saone et Loire contains two distinct coal fields. The largest of these (bassin du Creusot et de Blanzy) has 13 mining establishments, over a surface of 77,376 acres: only eight of these establishments were in course of prosecution in 1835. At Creusot, where the pits are deepest, the workings are 650 feet below the surface. A large proportion of the produce is used in the iron works at Creusot; the remainder is distributed, by the canal of the Centre, to the departments of the Upper Saone, and of the Upper and Lower Rhine. The smaller coal field in this department (Saone et Loire) has three mining establishments in operation, extending over 17,560 acres. The produce, which serves for almost all manufacturing purposes, is conveyed by a railway 17 miles long, to the Burgundy Canal, by means of which it is distributed through Alsace, and to the valleys of the Yonne and the Seine.

In Aveyron, there are three coal fields, for working which there are 23 mining establishments. The produce is for the most part used in the manufactories of Decazeville and de la Forezie. If the navigation of the Lot were improved, the coal of Aveyron might readily be conveyed to Bordeaux.

The Bassin d'Alais, in the department du Gard, although occupying a surface of 66,510 acres, and worked at 20 different points, produced in 1835, less than 50,000 tons. Nearly the whole that is raised is used in the iron works in the same district: the quantity is thus limited, because of the deficiency of roads or other means of distribution. A projected railroad, to connect the mines with the Rhone, and the Canal of Languedoc, would give a great impulse to mining industry in this quarter, by conveying the produce to Narbonne, Perpignan, Marseilles, and Toulon, thus rendering it available for steam navigation in the Mediterranean.

The Bassin de Littry, in Calvados, supplies fuel to Bayeux, Vire, and Caen. A part of the produce is used on the spot for lime burning. The first steam engine that was used in France was employed in 1749, to clear these coal pits of water.

The produce raised in the remaining 24 departments is so small that it would be trifling with the time of the Section to offer any particular account of their mines. A table is subjoined, in which are stated the quantity and value, in English measure and money, of the coal, lignite, and anthracite, respectively, raised in all the departments of France in each year from 1814 to 1836. It will be seen, from this table, that the produce has been increased from 675,747 tons, in 1814, to 2,583,587 tons in 1835, or 282 per cent. If this interval of time is divided into three nearly equal periods, the average annual produce in each period has been as follows:—

7 years—1814 to 1820, 792,496 tons.
8 " 1821 " 1828, 1,197,491 " Increase 51 per cent.
8 " 1829 " 1836, 1,835,831 " " 53 " from 2nd period.

The increase, comparing the 1st and 3rd periods, is 131 per cent.

The whole number of mines in operation in 1836, was:—

Coal	189	—employing	19,813	workmen.
Lignite . . .	44	"	1,181	"
Anthracite . . .	25	"	919	"
	258		21,913	"

Great as the increase has been of late years in the produce of the French coal mines, the inspectors give it as their opinion that it is very far from having reached its utmost limit. On the contrary, they predict that this branch of the national industry will shortly exhibit a more rapid progress than any hitherto seen. Large establishments are in the course of formation in the great field of the Loire, as well as in other localities; and it is expected that the opening of cheaper means of communication will give an impulse to coal mining in quarters where it has hitherto been scarcely attempted.

Statement of the Quantity and Value of Coal, Lignite, and Anthracite raised in France, in each year, from 1814 *to* 1836.

Y'rs.	COAL.		LIGNITE.		ANTHRACITE.		TOTAL.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
		£		£		£		£
1814	636,835	261,112	23,086	9,161	5,689	1,824	665,610	272,097
1815	715,276	324,823	23,300	11,608	5,735	1,985	744,311	338,416
1816	764,785	322,648	25,504	11,239	4,723	1,646	795,012	335,533
1817	815,229	342,976	27,340	16,060	4,572	1,579	847,141	360,615
1818	723,471	313,704	29,600	14,562	5,018	2,120	758,089	330,386
1819	761,800	333,518	44,113	11,846	8,037	4,374	813,950	349,738
1820	871,980	370,114	43,977	21,464	7,405	3,827	923,362	395,405
1821	913,213	395,771	39,122	19,344	5,676	2,490	958,011	417,605
1822	950,899	400,842	48,603	21,316	8,220	3,773	1,007,722	425,931
1823	950,642	404,846	49,194	22,399	9,313	4,507	1,009,149	431,752
1824	1,065,016	435,695	41,032	19,897	13,222	6,481	1,119,270	462,073
1825	1,176,538	482,698	59,242	25,008	23,374	9,915	1,259,154	517,621
1826	1,217,963	520,812	68,116	29,201	14,966	5,992	1,301,045	556,005
1827	1,344,432	557,130	57,838	35,214	25,483	12,185	1,427,753	604,529
1828	1,403,239	565,733	64,939	26,764	29,647	14,969	1,497,825	607,466
1829	1,378,136	539,847	59,719	22,747	32,512	16,884	1,470,367	579,478
1830	1,477,513	582,118	64,348	24,600	30,761	16,221	1,572,622	622,939
1831	1,403,124	549,452	52,513	19,723	30,631	16,726	1,486,268	585,901
1832	1,549,636	600,389	69,177	22,314	38,398	20,483	1,657,211	643,186
1833	1,633,776	672,893	58,274	26,160	45,180	25,288	1,737,230	724,341
1834	1,962,085	748,946	86,064	31,166	53,987	30,715	2,102,136	810,827
1835	1,957,022	793,281	101,508	39,433	57,603	32,532	2,116,133	865,246
1836	2,394,299	1,000,018	96,240	36,514	54,296	27,750	2,544,835	1,064,282

In this table, metrical quintals are converted into English tons, at the rate of 10.1465 metrical quintals to a ton, and francs are reduced to sterling money at the exchange of 25 francs per pound sterling: fractions are discarded.

During the years embraced in the foregoing table, the use of coal in France has been increased in a greater degree than the productiveness of the mines, as will be seen from the following statement of the quantity imported for consumption (*commerce special*) in each year from 1815 to 1836:—

	Tons.		Tons.
1815	245,653	1826	495,325
1816	315,815	1827	531,800
1817	235,269	1828	570,010
1818	277,624	1829	539,247
1819	234,102	1830	621,459
1820	276,705	1831	533,259
1821	315,785	1832	567,251
1822	332,192	1833	686,118
1823	321,497	1834	730,281
1824	456,644	1835	755,365
1825	499,325	1836	949,373

The greater importations of the last three years have been encouraged by a partial diminution in the rate of duty on consumption—a measure rendered necessary by the rapid extension of steam navigation. This great invention, which appears to be only now beginning to develope its full energies, will probably soon compel a further relaxation on the part of the French government, and will in various ways cause a great and permanently-extending increase to this most important branch of the mining industry of England.

[TO BE CONTINUED.]

Galvanization of Metals; or Patent Processes for their Protection from Oxidation, by coating or covering them with Zinc.

In our last volume, (p. 122,) we published a general description of the invention of M. Sorel, of a means of preservation of metals from oxidation, by taking advantage of the galvanic or electric action which results from the contact of two metals, relatively negative and positive; also reports of various eminent chemists upon the efficiency of the preservative means. The process was originally patented in France by the inventor, and was brought into public notice by a joint stock company, the shares of which were in great demand, and attained to an enormous premium in the market. In consequence of the favourable reception the invention met with, monopolies were secured in almost every country in Europe, and in America. The British patents were obtained, in the first instance, by communication of the invention to Captain Craufurd, and of the subsequent improvements of M. Sorel, to M. Lecomte de Fontainemoreau. The "British Galvanization of Metals Company" is, we understand, preparing to apply the invention to practice on a most extensive scale; Messrs. Crawshay, and some of the most extensive iron masters in the kingdom, being interested in the business.

In a matter which bids fair to be one of the most important of the age, in connexion with metallurgy, we are happy to be able to lay before our readers full and authentic particulars of the various processes employed—including the substance of all the patents which have been obtained, and the most recent improvements in the process.

First;—the mode of preparing the metals, or articles of metal, to be coated or covered with zinc.—The plates, or other articles of metal, are to be cleansed of rust, or other extraneous matters which may be adhering to them, in the following manner: They are to be immersed in a bath of water, acidulated with sulphuric acid, which acidulated water, if used hot, should be used is a leaden vessel, or if used cold, in a wooden vessel. Plates, or sheets, of metal should be placed vertically in the bath. The plates of metal, or articles of metal, are allowed to remain in the acidulated bath till the rust, or other extraneous matter, becomes loose, or easy of being detached; they are then to be taken out and thrown into cold water, from whence each piece, or article, is taken separately, and scoured with fine sand and a piece of cork, or by any other convenient and suitable means; rubbing them occasionally with a brush, as the scouring proceeds, after which they are again thrown into water, to remove the loosened particles of rust or dirt. Small articles, such as nails, hooks, and the like, which cannot be conveniently scoured with sand, need only be washed or rinsed when taken out of the acidulated bath. Another method of cleansing, or preparing, the metals, or articles of metal, is to wash them separately, (except where they are so small that this cannot be done conveniently) either in a solution of sal-ammoniac, or in a bath composed of about equal quantities of water and muriatic acid. In cases where the sulphuric acid bath is used, the metals or articles of metal may remain therein, without injury, for some time; but when the muriatic bath is used, the metals, or articles of metal, should be dried and coated, or covered, with the zinc as quickly as possible, otherwise the metals, or articles of metal, are speedily rusted or oxidized, by the muriatic acid adhering thereto. Where, however, it is not convenient to coat or cover the metals, or articles of metal, immediately after they are taken out of the bath, they may be preserved, temporarily, from rust or oxidation, by depositing them in lime-water, or some other alkaline solution. In all cases, the metals or articles, should, previously to being coated or covered with zinc, be dried, by being held or placed near a fire, or over a reverberatory furnace.

Second;—as to the crucibles, or vessels in which the zinc is to be melted.—The zinc is to be melted in a crucible of earthenware, or in a crucible of iron, or iron vessel similar to those used in tinning sheet iron, lined internally with bricks, connected with potter's clay, or other earthen substances, so as to prevent any contact between the zinc and the iron, which would not only produce an alloy of zinc and iron, but cause the crucible to be destroyed, besides preventing the zinc from adhering to the metals, or articles of metal, desired to be coated or covered. The method which has been found to answer most efficiently in practice is, to melt a considerable quantity of lead in an iron crucible, and to drop upon the melted lead an iron hoop of such diameter as just to fit within the interior of the crucible, so as that a part of the hoop shall be immersed in the lead, and part project above the surface. The zinc is added to the melted lead, and when it is fused, being lighter than lead, and not combining to any material extent therewith, always remains at the surface, and only comes in contact with the inner rim of the iron hoop, plunged in the lead in the crucible. Any opening which there may be between the hoop and the crucible, is stopped up with clay, to prevent any zinc getting between the hoop and the crucible. By these means, the zinc, instead of spoiling or destroying the crucible, only spoils or destroys the hoop, which can easily be replaced by another, or others, from time to time. Instead of an iron hoop, an earthen one may be used in the same manner as already described of the iron hoop. The best method of heating the crucibles is, to surround them with either coke or charcoal.

Third;—as to plates of metal, or articles of metal of a large size. The zinc being melted in manner before described, must be skimmed carefully, and its surface covered with sal-ammoniac, rosin, borate of soda, black or white, or other flux. The operations of covering, enveloping, or plating, should be performed as soon as may be after the zinc, or alloy of zinc, is in a state of fusion, as at a high temperature it would rapidly volatilize the sal-ammoniac, or other material employed as just described, to cover its surface. The plates or articles of metal having been cleansed, or prepared as before described, are to be taken hold of by means of a pair of tongs or forceps, with very narrow-pointed nippers, in order that as small a mark as possible may be left upon the plates, or articles of metal; they are then inserted in the fused zinc, moved about gently, and drawn out slowly, so as not to take up too much of the zinc, and yet so as that the zinc shall not have time to set, or become hard upon the surface of the plates, or articles of metal, covered. The plates, or articles of metal must then be thrown into clean water, and rubbed therein with a sponge or brush, and afterwards dried by passing them through bran, or saw-dust: without this washing and rubbing, the plates, or articles of metal, would be defaced by black spots. Additional clearness and whiteness may be given to the plates or articles of metal, by dipping them rapidly in water acidulated with sulphuric acid, previously to their being thrown into the clean water. Large plates, or articles of metal, must be introduced very slowly into the fused zinc, because when suddenly plunged in, explosions are apt to take place. Where plates of metal warp or bend in consequence of the heat of the zinc into which they have been dipped, or otherwise, they must be passed between rollers, being first powdered or sprinkled with rosin, sand, or some powder of a nature to prevent slipping, as they pass between the rollers. Plates of about the size of ordinary tin plates may be zinced several at a time, by being placed in a grated case with handles, care being taken to keep the plates apart from one another in the grated case. When chain cables or other large chains are zinced, upon being withdrawn from the crucible they are to be shaken, in order to prevent the links from becoming joined or soldered one to another. Cannon balls and other large articles should be heated in a reverberatory furnace, or otherwise, previous to their being zinced. Where articles have screws, or other parts which do not require to be protected, the said screws and other parts may be covered with a thin coating of clay. Vacant, or cut-out places in articles may be stopped up with wood.

Fourth;—in certain cases it may be found expedient to apply a second coating of tin. For example, in cases of large sheets or pieces of metal which may be placed in contact with substances which might corrode the zinc, or in cases of vessels intended to receive acids, or to be used in the preparation of food, where it is necessary that the zinc coating should be covered with tin, pure tin, or tin mixed with two thirds of lead, is in such cases to be melted in an iron crucible, and covered with a layer of fat or tallow, about two inches thick; the articles having been rubbed with a sponge or brush, moistened with a solution of sal ammoniac or muriatic acid, are to be quickly plunged into the melted tin and drawn out slowly, that the tin may properly cover the zinc. The melted tin, or melted tin and lead, should be kept at such a heat as almost to inflame the tallow upon the top thereof.

Fifth;—process of covering with zinc small pieces of metal, such as nails, small chains, and the like.—Articles of this description being immersed in the acidulated bath before described, must be moved about so that the acid may act as equally as may be on every part, and so that by the friction of the pieces one against another, the oxide and dirt may be removed. They are then dipped in muriatic acid and dried in a reverberatory furnace, and the coating of zinc given in either of the following modes: the zinc (which should be very pure) being fused in a crucible, (small if of iron, to avoid spoiling any large quantity of zinc), and covered with sal ammoniac or other suitable material, the articles to be coated are thrown therein, and allowed to remain for about one minute. They are then taken out slowly with an iron skimmer, and by small portions at a time, allowing as much as possible of the superfluous zinc to drop off. The articles so taken out of the crucible are, upon cooling, necessarily soldered or attached together by the zinc, of which there is besides a considerable excess attached to them; to free them from all that zinc which is not wanted for the purpose of protection, the articles are put into a reverberatory furnace and covered with charcoal: a red heat is then maintained for about a quarter of an hour, and the combined mass of charcoal and zinced articles is mixed, stirred, and shaken by means of an iron rod or poker, until the excess of zinc has been separated from the articles; being then drawn to the front of the furnace by an iron rake or other means, they are kept in agitation until the zinc or alloy is set. The remainder of the process is the same as in the case of large articles before described. But a still more convenient and efficient process of coating nails and other small articles is that which follows:—the articles are placed in a wire basket, which is plunged in melted zinc, covered with a layer of sal ammoniac or other suitable material; the basket is then drawn out of the fused zinc, and carefully shaken, so that any excess of zinc adhering may fall off; after which it is thrown into water or other fluid, not of a nature to attack the sal ammoniac or other covering material used. It is of importance to seize the proper moment for throwing the articles into the water, but the tact necessary in this respect is probably to be acquired by practice only. A perforated cylinder, or any machine of a similar kind, revolving on its axis, may also be used for finishing the nails and other like articles. As soon as taken out of the melted zinc they should be thrown into the machine then revolving on its axis; and this machine should be kept at a degree of heat sufficient to prevent any superfluous zinc stopping up the holes.

Sixth;—to zinc wire.—The following is the method adopted; the wire having been previously prepared in manner before prescribed, is wound upon a drum or cylinder, and one end of the wire being introduced into the fused zinc, covered with sal ammoniac or other suitable material, it must be made to pass horizontally through it, and maintained in a proper direction, and with a proper degree of motion, by any suitable contrivance, and as it emerges from the zinc bath, it must be rolled upon a second drum or cylinder, and afterwards cleaned and finished in the same manner as recommended for other articles.

Seventh:—process for zincing fire-arms and polished and filed steel articles. The zinc employed for this description of articles must be very pure, and if melted in earthenware crucibles, these crucibles must, where the articles are large, be placed inside other crucibles of wrought iron or cast iron, the empty space between the earthen and cast iron crucibles being filled up with fine sand or lead; the melted zinc is then covered over with sal ammoniac or other suitable material, as in the other methods; but to prevent the sal ammoniac or other suitable material from staining the articles by adhering to them when they are drawn from the melted zinc, some earthy substances, such as gravel, sand, lime, or chalk, in pieces or powder are mixed therewith. After the articles to be zinced are well covered over with the zincing, they are polished. First, all unevenness in the zinc coating is made to disappear, which is effected by means of files or scrapers; afterwards, pumice stone, sand stone, or emery, or glass paper, is used, and then the polishing is terminated as in the case of any other metals. It is important not to use hard bodies to make the coating smooth and give the polish; cork, leather, rags, or other similar things, should be employed. Without this precaution the zinc might be rubbed off in some places. It is to be observed, that to take the polish well, the articles should not have been polished previously to the zincing.

Eighth;—process of making zinc powder.—The zinc is put into a reverberatory furnace, every opening that would admit the atmosphere being carefully closed, and the temperature of the melted zinc raised to a degree approaching red-heat. The door of the furnace is then opened or lifted, and the zinc skimmed; after which, one-tenth of its weight of wrought (not cast) iron filings moistened with muriatic acid (to which some sal ammoniac may be added) is thrown into the fused metal, it being stirred all the while. After the introduction of the filings, the surface of the zinc must be covered over with fine charcoal powder, and the temperature carried to about the cherry-red heat, at which temperature the zinc must be maintained for about one hour, stirring it occasionally with an iron rod or poker. The metal is then conveyed into a brick, earthen, or cast iron, trough, and covered over with a lid of cast iron to exclude all contact with the atmosphere, and is stirred by means of an iron rod passing through a hole in the cast-iron door or lid, until, by cooling, it becomes so solid, that it can be stirred no longer. When quite cool it is ground into powder, and the more friable it is found to be the better the operation has succeeded. The powder thus obtained will preserve from oxydation copper and iron, polished and filed steel, such as clock work, articles of hardware, ironmongery and the like, by merely covering the articles with the powder, and this, even though they should be exposed to wet or damp.

Ninth;—process of making and applying zinc paint and paste.—The zinc may be also applied through the medium of a paint or paste, in the following manner: The powder of zinc is mixed with any of the unctuous substances generally used in paints and varnishes. The substances which have been found to answer best, are those which partake of the nature of the zinc, that is, are conductors of galvanic fluid, and hence this paint has been commonly called galvanic paint. Very good paint is to be made with oil distilled from the refuse tar of gas manufactories, adding one-third of spirits of turpentine. Oil varnish may also be used, but it is objectionable on account of its high price. Linseed oil may be employed, as it is in common paint, but it is not quite so favourable to the galvanic effect. White lead, or ceruse, may be added to the paint to give it more consistence. The proportions of the materials of the paint depend on the substances with which the zinc powder is mixed, and on the uses to which the paint is to be applied. With the same powder a paste may be made by rubbing copper, steel, and filed or polished iron, with which, they will be effectually protected. This paste is made with melted wax; into which is put ten times its weight of powder of zinc, and about 1-50th of tallow or oil.

Tenth;—process of making a zinced paper.—For protecting small polished metal articles, a zinced paper, or wrapper, is employed, manufactured by mixing powder of zinc, ground very fine, with the pulp of the paper while making, or by powdering common paper previously covered with some adhesive substance, such as gum, or flour paste, taking care always to exclude the use of animal glue, which has a tendency to cause the iron to rust.

Eleventh and lastly;—process of plating copper, iron, and other metals with zinc.—Solid plates of zinc may be combined with other metals for their protection from oxydation, by plating in the following manner:—The iron, copper, or other metal, being previously cleansed by the acidulated bath, in the manner before described, it is covered with thin sheet zinc, well powdered with sal ammoniac, and the two sheets of metal are passed through heated rollers, from which they are received into water in a state of perfect adherence. London Mec. Mag.

On Caoutchouc. *By* ANDREW URE, M. D., F. R. S., &c. &c.

(TO THE EDITOR OF THE LONDON JOURNAL OF ARTS.)

SIR,—Since writing the article CAOUTCHOUC for my "Dictionary of Arts, Manufactures, and Mines," now in course of publication, I have received, from several quarters, some valuable information; and have also made a series of experiments upon the subject, the results of which I have now the pleasure of transmitting to you for insertion in your journal.

Hitherto the greater part of the caoutchouc has been imported into Europe from South America, and the best from Para; but of late years a considerable quantity has been brought from Java, Penang, Sincapore, and Assam. About twelve months ago, Mr. William Griffith published an interesting report upon the *Ficus-elastica*, the caoutchouc tree of Assam, which he drew up at the request of Captain Jenkins, agent in that country to the Governor-General of India. This remarkable species of fig tree is either solitary, or in twofold or threefold groups. It is larger and more umbrageous than any of the other trees in the extensive forest where it abounds, and may be distinguished from the other trees, at a distance of several miles, by the picturesque appearance produced by its dense, huge, and lofty crown. The main trunk of one was carefully measured, and was found to have a circumference of no less than 74 feet; while the girth of the main trunk, along with the supports immediately round it, was 120 feet. The area covered by the expanded branches had a circumference of 610 feet. The height of the central tree was 100 feet.

It has been estimated, after an accurate survey, that there are 43,240 such noble trees within a length of 30 miles, and breadth of 8 miles of forest near Ferozepoor, in the district of Chárdwár, in Assam.

Lieutenant Veitch has since discovered that the *Ficus-elastica* is equally abundant in the district of Naudwar. Its geographical range in Assam seems to be between 25 deg. 10 min. and 27 deg. 20 min. of north latitude, and between 90 deg. 40 min. and 95 deg. 30 min. of east longitude. It occurs on the slopes of the hills, up to an elevation of probably 22,500 feet. This tree is of the banyan tribe, famed for "its pillared shade, where daughters grow about the mother tree," which has furnished the motto *tot* *rami quot arbores*, to the Royal Asiatic Society. Species of this genus afford grateful shade, however, in the tropical regions of America, as well as Asia.

Many species of other trees yield a milky, tenacious juice, of which birdlime has been frequently made; as *Artocarpus integrifolia*, and *Lakoocha*, *Ficus indica* and *religiosa*, also *F. Tsiela*, *Roxburghii*, *glomerata*, and *oppositifolia*. From some of these an inferior kind of caoutchouc has been obtained.

The juice of the Ficus-elastica of Chárdwár is better when drawn from the old than from the young trees; and richer in the cold season than in the hot. It is extracted by making incisions a foot apart, across the bark down to the wood, all round the trunk, and also the large branches, up to the very top of the tree; the quantity which exudes increasing with the height of the incision. The bleeding may be safely repeated once every fortnight. The fluid, as fresh drawn, is nearly of the consistence of cream, and pure white. Somewhat more than half a *maund* (42 libs.) is reckoned to be the average produce of each bleeding of one tree; or 20,000 trees will yield about 12,000 maunds of juice; which is composed in 10 parts, of from 4 to 6 parts of water, and, of course, from 6 to 4 parts of caoutchouc. The bleeding should be confined to the cold months, so as not to interfere with, or obstruct, the vigorous vegetation of the tree in the hot months.

Mr. Griffith says, that the richest juice is obtained from transverse incisions made into the wood of the larger reflex roots, which are half exposed above ground, and that it proceeds from the bark alone. Beneath the line of incision, the natives of Assam scoop out a hole in the earth, in which they place a leaf of the *Phrynium capitatum*, Lin., rudely folded up into the shape of a cup. He observes that the various species of *Tetranthera*, upon which the *Moonga* silk worm feeds, as also the castor oil plant, which is the chief food of the Eria silk worm, do not afford a milky caoutchouc juice. Hence it would appear that Dr. Royle's notion of caoutchouc forming a necessary ingredient in the food of silk worms, and being "in some way employed in giving tenacity to their silk," seems to be unfounded. If Botany discountenances this idea, Chemistry would seem to scout it altogether, for silk contains 11.33 per cent. of azote, and caoutchouc contains none at all;* being simply a solid hydro-carburet, and, therefore, widely dissimilar in constitution to silk, which consists of oxygen 34.04, azote, 11.33, carbon 50.69, and hydrogen 3.94 in 100 parts.

This hydro-carburet emulsion is of common occurrence in the ORDERS *Euphorbiacia* and *Tulicea*, which may be looked on as the main sources of caoutchouc. The American caoutchouc is said to be furnished by the *Siphonia elastica*, or the *Hevea guianensis* of Aublet, a tree which grows in Brazil, and also in Surinam.

Dr. Royle sent models of cylinders, of 1½ to 2½ inches in diameter, and 4 or 5 inches in length, to both the Asiatic and Agricultural Societies of Bengal, to serve as patterns for the natives to mould their caoutchouc by. Mr. Griffith says that this plan of forming the caoutchouc into tumblers or bottles, as recommended by the committee of the London Joint-stock Caoutchouc Company is, in his opinion, the worst that can possibly be offered; being tedious, laborious, causing the caoutchouc to be blackened in the drying, and not obviating the viscidity of the juice when it is exposed to the sun. He recommends, as a far better mode of treating the juice, to work it up with the hands, to blanch it in water, and then subject it to pressure. I shall presently describe a still better method which has recently occurred to me, in experimenting upon the caoutchouc juice. This fluid, with certain precautions, chiefly exclusion from air, and much warmth, may be kept in the state of a creamy emulsion for a very long time.

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* See my paper on the ultimate analysis of vegetable and animal substances, in the Phil. Trans. for 1822.

New Experimental Researches of Caoutchouc.

The specific gravity of the best compact *Para* caoutchouc, taken in dilute alcohol, is	0.941567
The specific gravity of the best Assam is	0.942972
" " Sincapore . . .	0.936650
" " Penang	0.919178

In the process of making the ELASTIC TISSUES,* the threads of caoutchouc are first of all deprived of their elasticity, to prepare them for receiving a sheath upon the braiding machine. For this purpose they are stretched by hand, in the act of winding upon the reel, to 7 or 8 times their natural length, and left two or three weeks in that state of tension upon the reels. Thread thus *inelasticated* has a specific gravity of no less than 0.948732; but when it has its elasticity restored, and its length reduced to its pristine state, by rubbing between the warm palms of the hands, the specific gravity of the same piece of thread is reduced to 0.925939. This phenomenon is akin to that exhibited in the process of wire-drawing, where the iron or brass gets condensed, hard, and brittle; while it disengages much heat: which the caoutchouc thread also does in a degree intolerable to unpractised fingers, as I have experienced.

Having been favoured by Mr. Sievier, managing director of the Joint Stock Caoutchouc Company, and by Mr. Beale, engineer, with two different samples of caoutchouc juice, I have subjected each to chemical examination.

That of Mr. Sievier is greyish brown, that of Mr. Beale is of a milky grey colour; the deviation from whiteness in each case being due to the presence of aloetic matter, which accompanies the caoutchouc in the secretion by the tree. The former is of the consistence of thin cream, has a specific gravity of 1.04125, and yields, by exposure upon a porcelain capsule, in a thin layer, for a few days, or by boiling, for a few minutes, with a little water, 20 per cent. of solid caoutchouc. The latter, though it has the consistence of pretty rich cream, has a specific gravity of only 1,0175. It yields no less than 37 per cent. of white, solid, and very elastic caoutchouc.

It is interesting to observe how readily and compactly the separate little cloths or threads of caoutchouc coalesce into one spongy mass in the progress of the ebullition, particularly if the emulsive mixture be stirred; but the addition of water is necessary to prevent the coagulated caoutchouc from sticking to the sides or bottom of the vessel and becoming burnt. In order to convert the spongy mass thus formed into good caoutchouc, nothing more is requisite than to expose it to moderate pressure between the folds of a towel. By this process the whole of the aloetic extract, and other vegetable matters, which concrete into the substance of the balls and junks of caoutchouc prepared in Assam and Java, and contaminate it, are entirely separated, and an article nearly white and inodorous is obtained. Some of the cakes of American Caoutchouc exhale when cut the fœtor of rotten cheese; a smell which adheres to the threads made of it, after every process of purification.

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* See "Dictionary of Arts, Manufactures, and Mines."

In the interior of many of the balls which come from both the Brazils and East Indies, spots are frequently found of a viscid, tarry-looking matter, which, when exposed to the air, acts in some manner as a ferment, and decomposes the whole mass into a soft substance, which is good for nothing. Were the plan of boiling the fresh juice along with its own bulk of water, or a little more, adopted, a much purer article would be obtained, and with incomparably less trouble and delay, than has been hitherto brought into the market.

I find that neither of the above two samples of caoutchouc juice affords any appearance of coagulum when mixed in any proportions with alcohol of 0.825 specific gravity; and, therefore, I infer that albumen is not a necessary constituent of the juice, as Mr. Faraday inferred from his experiments published in the 21st vol. of the Journal of the Royal Institution.

The odour of Mr. Sievier's sample is slightly acescent, that of Mr. Beale's, which is by far the richer and purer, has no disagreeable smell whatever. The taste of the latter is at first bland and very slight, but eventually very bitter, from the aloetic impression upon the tongue. The taste of the former is bitter from the first, in consequence of the great excess of aloes which it contains. When the brown solution which remains in the capsule, after the caoutchouc has been separated in a spongy state by ebullition, from 100 grains of the richer juice, is passed through a filter and evaporated, it leaves 4 grains of concrete aloes.

Both of these emulsive juices mix readily with water, alcohol, and pyroxilic spirit, though they do not become at all clearer; they will not mix with *caoutchoucine* (the distilled spirit of caoutchouc), or with petroleum-naphtha, but remain at the bottom of these liquids as distinct as mercury does from water. Soda caustic lye does not dissolve the juice; nitric acid (double aquafortis) converts it into a red curdy magma. The filtered aloetic liquid is not affected by the nitrates of baryta and silver; it affords with oxalate of ammonia minute traces of lime.

In a continuation of this paper I shall lay before your readers, next month, several interesting facts concerning the manufacture of caoutchouc on the great scale, supplementary to the account given in my Dictionary of Arts, &c. Jour. Arts and Sciences.

February 18, 1839.

Hydrostatic Weighing Machine. By CAPTAIN ERICSSON.

The object of this invention is that of dispensing with the use of weights, in all ordinary weighing in which ounces are not counted. The principal features are:

1. That the instrument is not subject to any friction; hence, that its accuracy is not, like the balance, affected under heavy weights.
2. That the motion of the parts is almost imperceptible, wear and tear being thereby prevented.
3. That the weight may be read off the moment the article is suspended.
4. That by suspending the instrument in the ordinary hoisting tackles,

the precise weight of goods, &c. may be obtained by the very process of loading or unloading.

The annexed drawing, represents a section of the model.

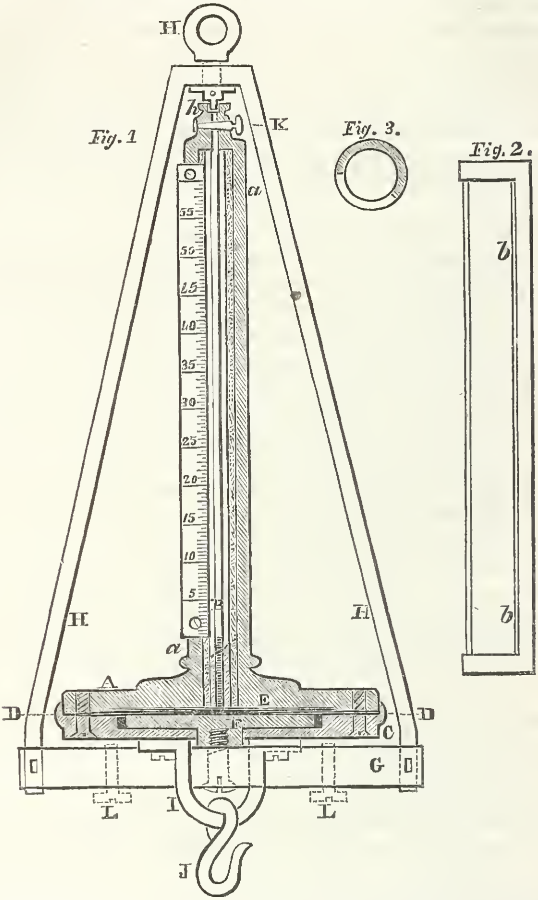

Fig. 1. A is a shallow inverted box of cast iron, with a hollow stem *a*, *a*; into this stem is inserted a glass tube B, bedded in plaster of Paris. C is a plate of cast-iron with a wide recess in it, firmly secured to the box A, a piece of India rubber cloth D, D, being inserted between them, so as to form a tight joint. E is a small quantity of mercury contained in the box A, and resting on the India rubber cloth D, D; this being supported by, and fixed to, a plate or piston F. This plate rests on, and is firmly attached by a screw to, the under cross-bar G; and this bar is suspended by two rods H, H, and the swivel eye-bolt H, which is partly inserted into, and made to slide in, the stem *a*, *a*, at *h*. I is a loop fixed to the bottom of the plate C, without touching the cross-bar G; it has a hook J correctly under the centre, to which hook the article to be weighed is suspended. K is a small stopcock, which may be shut whenever the instrument is not in use; it will prevent any mercury from escaping when moving the instrument, or should it chance to be placed in a horizontal position.

Rather more than one quarter of the circumference of the stem *a*, *a*, is cut away, to show the tube, and let the rise of the mercury be seen, the index-plate is screwed to one side of the opening. Though the glass tube is protected by nearly three-quarters of the stem *a*, yet a further security is provided for it when out of use. A tube like fig. 2, and 3 its section, is slid over the stem before the index-plate is screwed on: this slides round one way, to show the glass tube through its side-opening, and back again, till its margin *b*, *b*, comes against the index-plate, and shuts the glass tube quite up.

The plate F, with the mercury on it, is supported by the rods and eye-bolt, H. The weights of the stem, *a*, *a*, with all its parts, the plates A and C, the loop and hook, I, J, are always floating on the mercury; which, in consequence, rises in the tube to balance them. From this surface the number on the index begins. All articles to be weighed are, through the hook J, supported from the plate A, which causes it to press so much more on the mercury, and drive it up the tube enough to balance the weight appended.

It may be convenient to place two adjusting, or safety screws L, L, in the bar G, the upper ends of which shall stand high enough to prevent the plate *c* from descending so low as to spill the mercury over the top of the tube B, should any article be hung on whose weight exceeded the range of the instrument.

The limit of the power of the instrument for weighing will depend on the diameter of the piston and box, and the length of the glass tube; thus, for instance, a piston and box of about 16 inches in diameter, with a tube of 3 feet, would weigh above 3600 lbs. It is worthy of notice, that the greatest motion of the piston in an instrument of this size will only amount to $\frac{1}{100}$th of an inch.

The effect of changes in the temperature will, evidently, be an increase or diminution of the specific gravity of the mercury: this will, however, not affect the accuracy of the indication, for, though the mercury dilates more than the materials of which the box and piston are composed, still it can only affect the indication in a direct proportion to its expansibility; whereas the dilatation of the box and piston will counteract in proportion to the square of their expansibility. A slight error in the indication still remains, which will be completely corrected by fixing the index-plate at its lower end only, allowing the top free motion during changes of temperature. Regarding the construction of this instrument, it is of importance to make the bore of the glass tube, in all cases, $\frac{3}{16}$th of an inch, and the space between the circumference of the piston and the box should never exceed that dimension, however large the instrument may be. Trans. Soc. Encour. Arts.

A Resonant Spring for Table Clocks. By HENRY MAPPLE.

It is common in table-clocks, in order to get a deeper sound than is given by such bells as can conveniently be attached to them, to substitute for a bell a resonant spiral steel spring, which, when well made, will give a deep-toned, musical vibration when struck. In the French clocks the resonant spring is thin, and is fixed to the case by the centre or inner end, the case itself being made of maple, or some light wood. The sound given by the spring under these circumstances is very good, but such cases are liable to split in tropical climates. A considerable demand for such clocks exists in our colonies; and, in order to prevent the cases from splitting, English clockmakers generally have them made of mahogany or rosewood. The resonant wire is also thicker than that used by the French clockmakers, and is usually fixed by the outer end of the coil to the back plate, but the sound is rarely very good; the vibration, in the opinion of Mr. Mapple, being injured by a want of solidity and firmness in the part to which the spring is fixed. Mr. Mapple uses a solid block of iron, of the weight of about eight pounds, to which he attaches the spring by means of two screws, so as to make the contact between the block and the spring as complete and immovable as possible: the block itself is placed on the seat-board of the case. The form of the block he does not consider as of any great importance, for he has made the same weight into the form of a thick pillar, and found it to answer very well. A certain proportion, however, must be preserved between the spring and the mass of the weight; for, when this latter is very large, the sound is more or less absorbed; that is, a spring vibrating with a certain degree of power, is capable of putting into effective vibration only a certain mass of metal. Ibid.

The Tides.

In a Lecture on the tides, delivered at the Bristol Institution, at the request of the President and other members, by the Rev. W. Whewell, of Cambridge, it is stated that the complete formation of the science of the tides is a process which is not yet finished, but is now going on. It would be a great mistake to suppose that the labours which the entire application of the doctrine of universal gravitation requires are already terminated. In the case of the tides there remains much to do, and much in which many persons who feel an interest in the progress of science, may take a part. The inhabitants of Bristol have the means of contributing in a very eminent degree, to this object;—they have, indeed, already done much towards it. By the liberality of some of the public bodies of this city, a self-registering tide-machine has already been erected at the Hotwells. This machine is constructed by Mr. Bunt, and is incomparably the most accurate and complete of any that has yet been employed; an account of this machine has been read before the Royal Society of London, and is now in the course of being printed; and the sheets on which this machine records the time and height of every tide (some of which were exhibited) contains by far the best materials for future tide researches which have ever been produced. It would be a very great loss to science that these observations should not be continued, and the inferences drawn from them, which they are capable of furnishing. To do them justice, these observations ought to be treated in the same manner in which the astronomical observations of standard observation are treated; that is, they should not only be recorded, but constantly discussed and examined, with a view of obtaining a better knowledge of the rules which they follow, and with the intention of comparing them with theory as far as possible. Many individuals, and many cities, as Edinburgh, York, Glasgow, and Liverpool, have established astronomical observations; but the same expenditure and the same labour, if applied to the tides, would give results of greater value to science, because, in regard to the tides, more remains to be done. To do this in Bristol, would imply a sympathy with the progress of science, and a zeal for its promotion, which would be very suitable and noble accompaniments of the career of commercial prosperity, which, we trust, this city is destined to run. By establishing a permanent tide observatory, with a provision for the regular reduction of the observations, and the consequent constant improvement of tide tables, Bristol would render a greater service to science than any city has ever yet rendered. Naut. Mag.

Of Chemical Combinations, produced in virtue of the presence of Bodies which remain to continue the process. By Mr. Exley.

It has been observed, said Mr. Exley, that in many instances, powerful chemical affinities have been brought into activity by the presence of certain bodies which remain insulated. This Berzelius attributes to a peculiar force, which he calls catalytic force. Several reasons are adduced to show that this catalytic force is but one species of the general effects which occur usually in chemical actions, all of which are modifications of universal gravity arising from circumstances. The actions of this force were illustrated in four instances:—First, said Mr. Exley, a piece of spongy platina, about the size of a pea, is placed before a fine jet of hydrogen: this produces the combination of oxygen and hydrogen, raising the temperature till ignition occurs. To explain this by my general principles, it must be observed that, as in all metals, so especially in platina, because of its great density and atomic weight, the sphere of repulsion is very small. Hence, the ethereal atmospheres of its atoms are very dense, on which account the atoms of other bodies are drawn very nearly into combination, and thus, by its influence, the atoms of oxygen and hydrogen are brought so near together as to effect their union; caloric is given out; this favours the like union of other atoms, till ignition is produced. The effect of a clear surface of platina in causing the combination of a due mixture of oxygen and hydrogen, depends on the same conditions. 2nd, Another example given, was the conversion of starch into sugar, by means of dilute sulphuric acid. 3rd, The conversion of sugar into alcohol. 4th, The conversion of the alcohol into ether, by means by sulphuric acid. Athenæum.

Researches on the Chemical Equivalents of certain Bodies. By Richard Phillips, Esq., F. R. S.

The author examines, by a new series of experiments, the truth of the theory of Dr. Prout and Dr. Thompson, namely, "that all atomic weights are simple multiples of that of hydrogen"—a theory which the late Dr. Turner had maintained is at variance with the most exact analytic researches, and, consequently, untenable. Although the experiments of Dr. Turner, and the inferences which he drew from them, agree very nearly with those of Berzelius, it still appeared to the author desirable to investigate this subject; and it occurred to him, that the inquiry could be conducted in a mode not liable to some of the objections which might be urged against the processes usually employed. Dr. Turner, having adopted a whole number, namely, 108, as the equivalent of silver, this substance was selected by the author as the basis of his inquiry into the equivalent numbers of chlorine, and some other elementary gases. It appeared to him, that the chance of error arising from the fusing of the chloride of silver might be entirely removed, and other advantages gained, by experimenting on silver on a large scale, with such proportions of the substances employed as were deemed to be equivalents, and instead of calculating from the whole product of the fused chloride, to do it merely from the weight of such small portion only as might arise from the difference between theoretical views and experimental results. The author concludes, from the train of reasoning he applies to the series of experiments so undertaken, that no material, and even scarcely any appreciable, error can arise, from considering the equivalent numbers of hydrogen, oxygen, azote, and chlorine, as being 1, 8, 14, and 36 respectively. Ibid.

The New Waterproof Clothing.

In the variable climate of England, it has long been a great desideratum to obtain an effectual means of rendering clothing impervious to rain, without impeding the free escape of perspiration. This important object has at length been most completely attained by an invaluable discovery first publicly introduced by Mr. Walter Berdoe, tailor, 69, Cornhill, and now coming into general use. In consequence of its having hitherto been viewed as an utter impossibility for a garment to resist water, yet to admit air, this discovery will by many be viewed with mistrust; but as seeing is believing, those who doubt are invited to do as we have done, examine and judge for themselves; the result will amply repay them for their time and trouble. We were shown a great variety of samples of all kinds of cloths, gambroons, camlets, merinos, doe-skins, &c., containing water, and having retained it from one to three months, without the least appearance of even dampness on the underside. Boiling water may be poured on the surface of the material, when the steam will pass through while the water is retained. The breath will also freely pass through perfectly unrestricted, as may be seen against a mirror. Such results must at once remove all doubts as to the efficiency of the waterproof, as well as its entire freedom from what is so justly objected to in the unsightly and unhealthy Macintosh, namely, its being air-tight, and consequently preventing the escape of the insensible perspiration. Farm. Mag.

On the Employment of Polarized Light, for the purpose of showing the differences of Isomeric Combinations. By M. Biot.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

M. Berzelius having just addressed a learned letter to the Academy, announcing the extension of the characters of Isomerism to a great number of organic products, I thought I might usefully seize the present occasion to propose to chemists the use of optical processes, as a fit means of aiding them frequently in the study of these bodies, by furnishing sensible indications of their real molecular constitution, both in their isolated states and in the compounds, which they form, without having to fear, in either of these conditions, any chance of decomposition resulting from the means made use of.

The bodies called isomeric furnish the most singular case of chemical mechanism. Containing the same ponderable principles, united in the same proportions, they present, nevertheless, affinities, or at least certain chemical affections dissimilar to each other, which obliges us to regard them as distinct molecular systems. These two results, apparently contrary, are easily reconciled if we imagine that in these bodies the complete groups which exert chemical action without disunion, contain different numbers of similar atoms formed by the union of their elementary principles; or that these atoms, in equal number, are arranged differently among themselves; or, lastly, that both these kinds of dissemblance take place at the same time. The idea thus formed of Isomerism is even the necessary expression of it, if ponderable principles alone are concerned in the constitution of bodies. It is, at least, the first and most simple that we can entertain until its insufficiency is proved.

The choice between the several possibilities thence just pointed out, is obtained by comparing the ponderable proportions of each body which unite to other bodies to form compounds of the same order; but it is not always equally easy to produce a manifestation of these relations.

For example, the essential oils of citron and turpentine, brought by successive rectifications to a state of permanent composition, have been recognized by several very able chemists to be exactly isomeric. They are found to consist of hydrogen and carbon united in the common proportion of 23 parts by weight of the first, with 177 of the second. But by combining each with a third body, hydrochloric acid, an essential difference is at once perceived. Each separates at first into two portions, still isomeric, which, uniting with the acid, give two products, one liquid, which has hitherto been but little examined, the other solid, which has been carefully analyzed. Now, in the latter, we find an unequal weight of the two essences united to an equal portion of the acid: the relation is as 1 to 2. Whence we conclude that the molecular group which constitutes the essence of turpentine, and which unites with the acid, contains in complex atoms, formed of hydrogen and carbon, a number double of that which constitutes the essence of lemons. This, however, applies only to the solid portion, which has been analyzed. In decomposing this product we no longer procure the essence, but a liquid isomeric with it, and differing from it in many external, physical characters. We know of no other fixed compound derivable from the two essences; and these are almost the only chemical evidences we have of the diversity of their molecular constitution. Now, the employment of polarized light adds the following; first, in sending a ray of this light through each of the two essences, we immediately perceive that their molecular groups are differently constituted; for they act in contrary modes upon the ray, each in the same manner as its hydrochlorate. And further, to bring the atomic intensity of their action, to a state of equality, requires, very nearly, the ponderable relation (rapport pondéral) of 1 to 2, which was found in the solid chemical compound, as M. Dumas remarked when I presented these comparative experiments to the Academy. The liquid obtained from this compound, when decomposed, may also be studied in the same manner. This I had occasion to do with respect to that from the essence of turpentine; first, on a specimen sent me by M. Dumas, and afterwards on others of perfect transparency, furnished me by M. Oppermann, and which were prepared with the greatest care.

A decided dissemblance with the primitive essence was perceptible in their external characters, though their isomerism still remained the same. May not the views thus obtained, in a direct manner from the constitution of molecular groups, as well of the two essences as of the compounds derived from them, be of some aid to chemistry, in cases where the means o research are so limited?

The utility of such a proof is still more evident when we know no body which forms with isomeric substances compounds of the same order into which their own groups enter in various proportions. Such is the case with tartaric and paratartaric acids. Analysis shows their composition to be identical. Experiment thus far appears to prove that in all their compounds of the same order, with other substances, each exhibits exactly the same proportions. This correspondence extends even into the series of modifications which they undergo when acted upon in the same manner in order to destroy them. Nevertheless, their different modes of crystalizing, especially their unequal solubility when disintegrated—an inequality which extends to several of their salts, is sufficient to prove indubitably that their molecular constitution is different; and these are, I believe, the only characters of dissimilarity by which chemists distinguish them. But dissolve them in water, for the purpose of minute division, and pass a ray of polarized light through the solutions, the diverse constitution of their particles becomes immediately apparent; for tartaric acid acts upon this light with a molecular power, sensible, measurable, and which extends to all the tartrates; while, under the same circumstances, no appreciable action of this kind shows itself either with paratartaric acid, or its salts.

The same method—I would willingly say, the same reagent, makes immediately manifest the diverse constitution of a great number of other isomeric substances. Berzelius now regards as isomeric, cane sugar, gum arabic, inulin, fecula, and dextrine. I need not discuss this opinion of the illustrious chemist. It may be that the analogies of the science which he cultivates dictate these agreements. If they become multiplied, if they are discovered to be essential, it will become more and more probable that bodies are not constituted of ponderable principles alone, or at least that these do not completely determine their properties, and this is a very possible truth. However this may be, the substances just named immediately evince diversities of molecular affections as various as positive when studied by polarized light. Cane sugar and fecula turn the planes of polarization in the same direction towards the right; but the intensity of their action is very different, and it is modified very diversely when the two substances are exposed to chemical agents, which change and transform them into other products. Gum arabic and inulin, dissolved in water, act on the polarized ray in contrary directions from the former. They turn the planes towards the left, and chemical reagents modify this effect very differently. The greater number of their reactions may be rendered, at will, slow or sudden. We may follow their progress through whole years under the combined influence of weather and temperature, or witness their accomplishment in a moment. The products formed have also, in general, very different rotary powers. The progress of their formation is so also, and when it ends in the production of saccharine matters, as is the case with the four substances which I have compared, these sugars show a distinction in molecular form by their rotary action. May not all this afford some assistance to chemistry in studying substances which seem identical in their composition, and of which it may be difficult to form distinct atomic arrangements?

I may be allowed to cite amidon as an example. Berzelius admits the accuracy of M. Payen's analysis of this substance and of dextrine. The commissioners of the Academy gave the same judgment. What do these analyses prove? that when fecula, which is primitively an organized globule of sensible dimensions, has been sufficiently disintegrated to allow its molecular groups to combine chemically with other substances, whatever may be the degree of attenuation and the nature of the chemical principles or mechanical processes employed to effect it, the groups obtained always show the same elementary composition and capacity of combination, so that their atomic formula is always the same. But polarized light proves precisely the same identity, and M. Payen willingly acknowledges that it was this constant identity which guided and sustained him in his delicate researches.

Shall I venture to say that these indications are in advance of the results of chemistry, and show dissemblances of molecular action in cases of isomerism, to which the science has not yet been applied. There is nothing more rigorously isomeric than an aqueous solution of tartaric acid, brought temporarily to temperatures a few degrees different in close vessels. But polarized light shows that the molecular affections of this solution vary progressively with the degree of the thermometer, and return to the same primitive state when the temperature is lowered to the same degree. Are we not to believe that these variations are accompanied by corresponding chemical changes in the groups, and which would be manifest if we had tests sufficiently delicate to appreciate them?

Finally, to the multiplied examples which might be given of these applications, I will only add that the same mode of observation may often serve to render sensible the temporary modifications which certain substances undergo when they combine with others endowed with a rotary power. M. Peligot may easily prove this, in the different soluble compounds he has formed of different kinds of sugar. Neither will this process be less fit to complete the character of the progressive changes which M. Frémy has effected in tartaric acid, by heat. In general, when we enter somewhat profoundly into the study of bodies, we soon find that they must be subjected to the most varied proof to discover the mysteries of their constitution; and the more different the nature of the processes applied, the more are the characters thus revealed valuable for the purposes of synthesis, on account of the very diverse mechanical conditions under which we may bring them together. Could it have been believed a few years ago, that impressions produced on liquids in motion, by the vibration of a musical instrument, would be the indication most immediately adapted to prove the physical mode by which their flowing is effected?

Ann. de Chem. et de Phys. Sept. 1838.

Progress of Civil Engineering.

The Thames Tunnel.—Copy of Mr. Walker's *Report to the Treasury, on the Works at the Thames Tunnel.*

In consequence of several propositions made to the Lords commissioners of her Majesty's treasury, for further means for continuing and facilitating the work, they directed James Walker, President of the Institution of Civil Engineers, to take into consideration the various papers relative to the late irruption of the river, with the special reports from Mr. Brunel, of the works proposed to be carried on at the tunnel, and to report to the treasury his views and opinions on the eligibility and means of prosecuting the work.

"I gave the subjects, (says the reporter), my immediate attention, and was preparing a report thereon, when on the 2nd November, another (the fourth) irruption of the Thames took place, and on the 6th, when I visited the works of the tunnel, Mr. Brunel, the engineer, and Mr. Charlier, the secretary, requested a postponement of my report for a short time, until they should complete an expected arrangement with the navigation committee of the river Thames, from which they expected increased facility and security. This request I communicated to Mr. Baring, by letter, on the 9th November.

I have since received Mr. Spearman's letter of the 2nd December, transmitting to me, by command of the lords of the treasury, a copy of a letter from the secretary to the Thames Tunnel Company, dated 15th November, together with a report of Mr. Brunel on the present state of the tunnel, and the best mode of proceeding, and also a plan of the works, with a request that I would communicate to their lordships my opinion upon the several points referred to in the papers, previous to their determining on the proposals and recommendations of the company.

Since receiving the above instructions, Mr. Spearman has stated to me the desire to be, that every point, particularly as respects cost or estimate, which I consider of importance in the general question of the tunnel, should be included in my report, so as to bring the whole fairly under the consideration of their lordships.

That Mr. Brunel's different reports in which the same recommendations are repeated, may be brought to their lordship's recollection, I shall give a short abstract of the main points in the order of date.

In his report of 2nd May, 1837, Mr. Brunel ascribes the difficulties which had retarded the progress of the tunnel for the last five months to the excessive rains of the preceding autumn, liquifying the ground between the ceiling of the shield and the river, and causing it to run into the works; he states that this has been augmented by his being deprived of the pumping-well and drain from Wapping, which is stated to have been originally intended, and to have been considered the most efficient means of drainage, particularly as the dip of the strata is to that side, and that before any satisfactory progress can be calculated on, the proposed pumping-well, with a drain or drift-way, should be made, but that a preferable plan would be to sink the fifty-feet shaft for the foot passengers' descent, which would, he considers, be a better means of drainage, and would give employment to the workmen when not in the shield. The fact of the pumping at the entrance of the London Docks having dried the wells in that neighbourhood, is adduced as a proof that a pumping-engine on the Middlesex side would diminish the land-springs in the tunnel.

Mr. Brunel estimates the expense of the shaft, including the steam-engine, pumps, &c. at 6,844*l.*, and the pumping-well alone, at 2,690*l.*, independent of the drift-way or drain, which he calculates at 4,310*l.*, making together 7,000*l.*, which sum he presumes would be saved by forming the shaft, rather than the well, at the present time, exclusive of keeping the workmen and establishment employed, and thereby reducing the amount which is now charged to the tunnel account. He also mentions the impregnation of the water with sulphurated hydrogen, which has proved very injurious to the health of the workmen, as another reason for making the drift-way, as it would be the most effectual means of drawing it off. The report states, that "the fact of sixteen feet of the tunnel having been completed under the described difficulties, is a proof that it can be accomplished, though, owing to the disadvantages, at an enormous price, and that it never could be intended in the conditions of the treasury that he should be deprived of the means of completing the work at the estimated cost."

Mr. Brunel's report, dated 9th August, 1837, recapitulates the substance of his previous report, and adduces the successful result of pumping-engines and drift-ways erected for the purpose of taking off the land-springs that impeded the formation of the Kilsby tunnel in the line of the Birmingham railway, as a proof of the good effect that would be felt in the works of the Thames tunnel by a pumping-engine on the Middlesex side. He states also, as an argument for the works he proposed in his former report, the importance of giving the disturbed and artificial ground time to consolidate, and now proposes, on the completion of the Middlesex shaft, to commence the tunnel on that side also, with a view to greater expedition and economy, and to keep the full complement of men more regularly employed by having the two ends to work at. This, it is stated, would reduce the cost of conveying the men, materials, and excavation to the shaft on the Surrey side. In this report Mr. Brunel further states, that as soon as the plan he has proposed is in satisfactory operation, the formation of the carriage roads might be commenced simultaneously with the tunnel, and that by the various means he now proposes, a saving might be effected in the time, of four and a half years, which, in my report of April 1837, I considered requisite for the completion of the tunnel and approaches, and that, consequently, there would be an earlier receipt of toll and a saving of current expenses and machinery to the amount of 15,000*l.*, by the works being completed one year and a quarter within the time I had calculated. Various accounts and calculations in proof of his several positions are appended to this report of Mr. Brunel, and an estimate that, to carry on the works as he recommends, the sum of 94,000*l.* will be required during one year from August 1837.

The lords commissioners of Her Majesty's treasury having refused their assent to the tunnel being begun on the Middlesex side, Mr. Brunel in his report, dated 7th September, 1837, repeats the other recommendations of his former reports.

The last report of Mr. Brunel that is referred to me, is dated 15th November, 1837, the fourth irruption of the Thames having taken place on the 2nd of that month. In this report he considers the third irruption (that of the 23d of August) as not having been unfavourable in one point of view, as it would enable substantial ground to be substituted for the loose silth that had worked into the tunnel by the irruption; in proof of which he states that the work done before the third irruption cost 900*l.* per lineal foot, while what was done between the third and fourth irruptions cost only 630*l.* The former recommendations and arguments are repeated, and in addition it is now stated that the fourth or last irruption was caused in a great degree by the part of the tunnel then in progress being under the portion of the river chiefly used for navigation, and that the depth being small, the artificial bed of the river, or roof of the tunnel, was liable to be disturbed by passing vessels. This, Mr. Brunel now proposes to remedy, by deepening a part of the river where the tunnel is formed, moving some of the ships in the tiers near the tunnel from the northern to the southern side of the river, according to a plan which accompanies his report, throwing the space which is required to be kept clear for the navigation from the north side towards the middle of the river, over where the tunnel is formed, so as to leave the space which is in advance of the works free for tunnelling operations, and then substituting a thicker roof of clay and gravel raised above the present level, to which, from the navigation not being then over that part, there would not be the same objection as at present. The thicker roof

Mr. Brunel proposes to make 100 feet in length, or in advance of the shield, and 100 feet on each side of it. He calculates on a great saving in the end from this artificial covering, which he estimates at 1,800*l*., and ascribes much of the late trouble and expense to the passing ships, and the want of a sufficient thickness in his roof, which the navigation prevented his having.

The reports are drawn up in great detail, and the above abstract is to be considered not as a substitute for them, but only as bringing the leading points to recollection in one view, without the repetitions which the reports themselves, being of different dates, naturally contain.

It is now my duty to state my opinion; which is, to recommend Mr. Brunel's proposal to be adopted, as the most economical and creditable way of executing the works, if it be the determination that the Thames Tunnel (a work which for many years has attracted much of the public attention in this, and still more in other countries, and upon which upwards of 80,000*l*. of public money has been advanced,) shall be completed, without making cost an element in the question. I would then even advise more effectual works in front of the shield than Mr. Brunel's description and estimate of 1,800*l*. contemplates; for if the work is to be considered a national or government work, a repetition of the danger, the late irruptions, and the enormous expense of the work, would be discreditable, and, as it may be, it ought to be prevented. In addition to Mr. Brunel's proposals, I would recommend, after the removal of the clay that has lately been thrown in, and a portion of the silth, that two rows of close whole timber piles should be driven between where the ground begins to rise and the present shield, one row on each side of the line of tunnel, with space between sufficient for the shield to travel, and to as great a depth as they can be conveniently driven, the heads being level with low water. These, with a return of shorter piles at the end, would form a dam against the silth. The piles being driven, I would continue the dredging of the silth in the space enclosed by the piles, and then fill up with clay, gravel, &c., as at present, to a sufficient height, and afterwards give the mass time for consolidation before attempting to advance the shield, which, in my report to the commissioners for the loan of exchequer bills, I stated to be an essential element for success in the undertaking. In the progress he has made through very bad strata, Mr. Brunel has fully tried and proved the great power of his excellent shield; but the strata, rendered worse by the irruptions and the causes assigned by Mr. Brunel, are now too bad for even the shield to overcome. By the substitution of good artificial soil to work through, and keeping the silth, or sand, back by the piles, there would be much less difficulty or danger; and with proper precautions, my decided opinion is, that the tunnel may be completed notwithstanding the late irruptions, and with comparatively little difficulty or risk.

Here the question naturally presents itself, at what cost? and to answer it with the probability of accuracy, is still very difficult.

The amount of the company's capital expended previous to any advance of public money was 180,000*l*.	
On the 27th February, 1837, when	64,600
received from the commissioners for the loan of exchequer bills had been expended, I estimated the addition then required to complete, at	310,000
Making, exclusive of the company's capital	£374,600

Between the 27th February and the 2nd November, 19,300*l.* have been expended, making 83,900*l.* of public money expended to the 2nd November, but the quantity of work done with the above 19,300*l.* is only 19 feet 6 inches, making, (inclusive of 1,400*l.* for pumping, excavating, and claying, after the third irruption,) nearly 1,000*l.* per foot, which very much exceeds all previous estimates, and proves what I stated in evidence before the select committee of the house of commons, that no prudent man would commit himself to the accuracy of an estimate of this work, while it shows also the impolicy of attempting to drive on the shield through the present bad soil without a sufficient covering, and time for consolidation.

In the present situation I consider that the sum of 150,000*l.* should be taken as the estimate for completing the tunneling; and that the shafts and other works remaining to be done, together with the purchases, should not be estimated under 200,000*l.*, making, with the 84,000*l.* of public money already expended, and the company's capital previously expended, a total of 614,000*l.* for the estimate of the work, or upwards of triple the original estimate, and this is allowing but a moderate sum for contingencies, which have heretofore been very heavy.

I have estimated the great descents at double Mr. Brunel's estimate, and yet I have, from the nature of the work, as much doubt as to the sufficiency of that sum as of any other item in my estimate.

If, however, in place of determining to complete the tunnel without reference to cost, which the foregoing observations suppose, the lords of the treasury resolve, as heretofore, to confine their operations to the advance of the tunnel, so as to remove any doubt of its getting through, before they sanction a further heavy outlay, then, although I agree with Mr. Brunel that the pumping-well or the shaft, with the drift-way, or drain, would lessen the springs, I do not by any means think them so essential to the progress of the work as to agree in recommending their being proceeded in at present. Up to the time of the second irruption, in January 1828, the works were under the uncontrolled management of the directors and engineers, and during that period nothing had been done on the Middlesex side with a view of draining the water from the tunneling, although it had then advanced to the middle of the river, only 155 feet having been done since, but in the report of 1831, the drift-way or adit is proposed and estimated, with the pumping-well, at 6,000*l.* Mr. Brunel informs me that the drainage in the tunnel is now very small, and the short time in which the water after irruptions has been taken out, proves that the present pumping-engine is fully equal to the work.

More rain, by two inches, fell during the last six months of 1836 than of 1835*, an increase, but not such as to cause a very important difference in the workings, which I ascribe almost entirely to the ground towards the Middlesex side being of a looser and more sandy and silthy nature than towards the south side; this, it has always been said by the Trinity officers and others acquainted with that part of the river, would be found to be the case; so that, although the spring-water has been an evil and an hindrance, the Thames water has been another and probably a greater, and is the present enemy, which makes the cases of the London Dock or the Kilsby Tunnel parallel to a certain extent only. It is not in preventing the communication with the spring, but with the river water, that the artificial roof of clay, &c., has been useful.

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* The quantity of rain that fell in the last six months of 1835 (as kept at the Royal Society's rooms) was 10½ inches, and in the corresponding period of 1836 it was 12½ inches. In the same period of 1834, a very dry year, it was only six inches.

I agree that the air for respiration would be improved by the drift-way, and probably the present air-pump, which is worked by the steam engine, rendered unnecessary; but this pump, ingenious as all Mr. Brunel's applications are, appears to completely answer the purpose, and would probably be found quite as effectual in abstracting the sulphurated hydrogen, as a drift-way at the bottom would be.

I cannot agree as to the saving of expense by the shorter distance to the Middlesex shaft; the difference of distance in the present situation of the shield would be only seventy yards, and as an excellent railway is laid, and machinery attached for working it by the steam engine, I am sure that the conveyance of the excavated soil along the bottom of the tunnel to the low ground on the Surrey side must be at least as cheap as to the Middlesex side, where the ground is chiefly covered with buildings, and does not require to be raised, and that, as a passage to and from their work, the workmen would generally prefer the spacious lighted tunnel to a drift-way, until the difference of distance is much greater than at present.

That the well, or shaft, on the Middlesex side would give employment to the miners and other workmen when they cannot be employed in the shield, and thus lessen the amount now charged to the tunnel, I entirely agree; but my opinion at the same time is, that they may be fully employed in securing the ground in advance of the shield, according to Mr. Brunel's plan, or with the additional piling, such as I have suggested. It appears to me that sinking the shaft, driving a drift-way, making a new shield, and proceeding from the Middlesex side, would amount to a committal to go through with the undertaking, and ought not to be begun until that, as a previous question, has been determined.

In stating this, I am in some measure influenced by the opinion that Mr. Brunel's estimate for the works on the Middlesex side is too low. He estimates the pumping-well and drift-way at 7,000*l.*, and the shaft-engine and pumps at 6,844*l.*, and gives a decided preference to the shaft. Now the shaft on the Surrey side is stated in the account to have cost 20,000*l.*, and evidently the drift-way, 4310*l.*, should have been added to the shaft, as to the well-plan. The Middlesex shaft may, and probably will, be less expensive than the Surrey one was; I think it unsafe to trust calculation against experience, so far as to take one-third of the actual of the Surrey, as the estimate for the Middlesex, shaft.

Of the propriety and importance of changing the channel for the passage of vessels, from the part of the river in front of the shield which has yet to be tunneled through, over to the part which is tunneled, and forming a body of compact gravel and clay in front of the shield, in the way Mr. Brunel proposes, to a greater thickness than is now compatible with navigation, there can be no question; and I am glad to learn, by a letter received from Mr. Charlier, that the Navigation Committee have agreed to the proposal, and as Mr. Brunel considers that this will remove much of the cause of the late irruption, by enabling him to have a better covering of clay, and preventing vessels grounding upon the artificial bed, and estimates the necessary work at only 1,800*l.*, I have no hesitation in recommending to the lords of the treasury to sanction it, even with the addition I have proposed, should Mr. Brunel be disposed to adopt it. I think the expense of the piling and clay may be taken at about 10,000*l.*, and I feel assured that, if the completing of the tunneling be the object, this outlay will be more effectual, and much less in amount, than proceeding with the works on the Middlesex side. From the length of the river proposed to be covered with clay, if done according to Mr. Brunel's plan, being three times greater than with piling suggested by me, I think the difference of expense of the two plans would be small.

Having now given my opinion on the various points that have been referred to me, I would beg to add that, as the Thames Tunnel is Mr. Brunel's work as respects design and responsibility, any measure that may be proposed for executing the work should, in my judgment, have his approval. If that approval is refused, unless the lords of the treasury will consent to works which exceed the amount they have yet thought proper to agree to, almost any course would be better than letting the complaint be repeated, "that the engineer has been deprived of the proper means of completing the work at the estimated cost." (Signed) JAMES WALKER.

December 1837.

Repertory Pat. Inv.

A Summary View of the Progress of Architecture in Britain during the Year 1838; *with some Notices relative to its Advancement in Foreign Countries. By* J. C. LOUDON, F. L. S. &c.

In conformity with the plan first adopted in our Third Volume, we proceed to give a short notice of the progress made in architecture in Britain during the past year (1838); though we fear that our readers will find this notice little more than the echo of our summary for 1837. The truth is, that, in drawing up an article of this kind, there is no medium between seizing on a few leading features, and remarking on them, and recapitulating an immense number of details, already given in the course of the volume for the current year. The latter plan is not consonant with our views of what such an article ought to be; and though, as we have just hinted, it may be difficult to discover any grand architectural feature to characterize 1838, yet we shall proceed with such as we can find; hoping, at all events, that the brevity of our article will be some apology for the absence of higher qualities.

If the existence of a general spirit for architectural improvement can be characterized as an architectural feature, this spirit may be safely affirmed to be on the increase, not only in London, but through all the provinces. In London, there is not a house rebuilt, that is not erected in a superior style to what it was before; and the renovation of all public buildings is, in general, effected in a very superior style. This system of improved renovation was first rendered conspicuous in the public-houses, and it has since been displayed, in a striking manner, by the banks and the insurance offices; and, more or less, by the shops, in all the principal streets. The employment, in Regent Street and Bond Street, of the Louis XIV. style in shop fronts is one of the latest improvements in this department; and, in combination with the immense panes of plate glass now used for shop windows, and accompanied by rich gilding on a pure white ground, it has a striking and most magnificent appearance.

The introduction of Roman cement, about thirty years ago, has been the foundation of much of the improvement which has taken place in the elevations of street architecture. During this year, and the preceding, a new cement for roofs, terraces, and roads, has been introduced, the basis of which is bitumen; but, whether this will lead to any great change, either in buildings, by the introduction of flat roofs, or in streets and roads, by becoming a substitute for either foot or road pavement, remains to be seen. Our opinion of it is, that it promises well; particularly for flat roofs, public footpaths, and garden walks.

The formation of general cemeteries exterior to towns may certainly be considered a feature which has become prominent during the past year. Besides several in the suburbs of London, and one or more in the larger towns, such as Birmingham, Liverpool, and Manchester, they are beginning to be formed in the secondary towns, such as Nottingham, Brighton, &c. We may remark of these cemeteries, that in no one of them, as far as we have observed or heard, are the grounds laid out in an appropriate manner. They are all arranged in imitation of a modern pleasure-ground; the expression of which cannot be considered as in accordance with that of a place of burial; nor are the windings of the walks favourable for economising the ground, which must necessarily be divided into portions of a rectangular form for the graves. Such, however, is the want of invention in persons who are employed to give plans for laying out grounds, whether of cemeteries or public gardens, that they can only repeat in them the winding walks and scattered groups, which they have learned mechanically to adopt in laying out the lawn and pleasure-grounds of a gentleman's villa.

The most striking architectural erections that have taken place throughout England during the last two years are, unquestionably, those connected with engineering. We allude to the magnificent bridges and viaducts erected along the railways, and the lofty engine chimneys, which, forming handsome columns of from 100 ft. to 300 ft. in height, mark the locality of some stationary engine, of waterworks, or of some manufactory. Brick columns of this sort are to be found in almost every part of the metropolis, and in all the great manufacturing towns of England, as well as in those of Scotland. Formerly, no architectural object was seen to rise above private buildings, except the spires and towers of churches; but now, in many parts of the country, and more especially in the north of England, the grand architectural features, which meet the eye of the traveller in the horizon, are the engine chimneys. Perhaps the very highest that has yet been erected in Britain is that at Carlisle, described at p. 165, of the present volume.* With respect to the bridges and viaducts, they are to be found in numbers on every line of railway. Some of the most remarkable are in the neighbourhood of Newcastle, on the railway leading to Carlisle, of which elsewhere, in this volume, we have given a short notice. Those on the Birmingham Railway are of extraordinary strength and massiveness; while those on the Bristol Railway are remarkable for their lightness and elegance. The former, those on the Birmingham Railway, may be said to be constructed agreeably to the maxims adopted by the late engineers, Rennie and Telford, of "stronger than strong enough;" and the latter, on what may be called the modern, scientific principle of "elegant sufficiency." The most perfect example of this last kind of engineering, which we have seen, is the viaduct over the valley of the Brent, at Hanwell, Middlesex.

In foreign countries, the most striking architectural feature that we are aware of is the Girard College, recently commenced at Philadelphia. It will be an edifice of classical form, of great magnitude, and so massively and solidly constructed, as to be apparently of endless duration. The account of this building, and of Girard, in the present volume, p. 446., will, we think, be found of great interest in a moral, no less than in an architectural, point of view.

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* Vide Journ. Frank. Inst., vol. xvii., p. 353.

In railroad engineering, the progress which has been made during this year is great; whether we look to the completion of some lines, such as that between London and Birmingham; the progress making by others, such as those from London to Bristol, and from London to Southampton ; or the commencement of some, such as those from London to Brighton, and from London to Dover. Our continental neighbours are making proportionate progress. A railroad from Calais to Paris is in contemplation ; and a survey has lately been made for one between Paris and Dieppe, which, when the Brighton rail road is completed, will reduce the time of traveling from London to Paris to one day, instead of three days, and two nights.

The subject of paving streets with asphalte, or cement, has already been alluded to. The substitution of blocks of wood, for blocks of stone, in carriage-ways, which has long been in use to a limited extent, in Russia and in some parts of Germany, and which has recently been tried in New York, is, also, proposed to be tried in London. Wheel-tracks of stone, formed in imitation of tramroads, for facilitating the progress of carriages on common roads, are now being laid down in some places, with a view, it is said, of trying how far locomotive engines on such roads can be brought into competition with rail road carriages.

The architectural literature of the year exhibits, as usual, a considerable number of books, all more or less valuable. Those which we think likely to become standard works are, Hood's *Treatise on Heating by Hot Water*, Britton's *Architectural Dictionary*, Wood's *Treatise on Railroads*, Nicholson's *Treatise on Projection*, and, perhaps, one or two others. The *Civil Engineer and Architect's Journal*, the first number of which was noticed in our preceding volume, p. 578., continues to be carried on with great care and industry, and has deservedly obtained an extensive circulation. Among the books which we have omitted, might, perhaps, have been mentioned Dr. Arnott's *Treatise on Warming and Ventilating;* but, believing that author to have erroneous views of the subject of ventilation, as pointed out in p. 230, of this volume, we cannot give unqualified commendation to his *Treatise*. Dr. Arnott's stove, however, as far as it concerns economy and heat, we consider to be the most perfect apparatus of the kind that has ever been brought into notice.*

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* This may be true as it respects Great Britain, but it will not hold good, we are well persuaded, in the United States.

Dr. Arnott's stove, if we may rely on the description given of it in the English journals, consists simply of a grate or chauffer placed in a casement of sheet iron, the gases passing through the several compartments of the casement, and thence into the chimney. The heat which is set free by the combustion, and evolved from the gaseous current will pass into the stove or casement, and radiate through the room. A portion of it, however, must reach the chimney, and warm the column of air contained in its flue, otherwise there will be no draught, and the coal will cease to burn. Now the true principle of economy in all such cases, as it regards fuel, as we apprehend the subject, is to retain all the heat in the room except that portion which is essential to the maintenance of the draught by keeping the flue warm. This can be done only, or mainly, by increasing the convolutions or windings of the gaseous current, or in other words, causing it to pass over a surface sufficiently extended to absorb nearly all its heat. There are many modes of accomplishing this object; and several that are in use in our anthracite stoves are, we think, decidedly preferable to Dr. Arnott's. The plan of Professor Olmsted, for instance, by attaching one or more radiators to the furnace, or fire cylinder, effectually secures the retention of the heat in the room, while it prevents the heated surface from becoming so hot as to carbonize the animal and vegetable particles that are constantly floating in the air, and thus deteriorate its quality. Another material advantage of these radiators is that the

In comparing the present Volume of the *Architectural Magazine* with those which have preceded it, we think we are justified in saying that it is not inferior, either in the excellence of the papers which it contains, or in the variety of subjects which have been discussed in it, or brought into notice. One series of papers, commenced in the last Volume and concluded in the present one, we consider to be of particular value to the young architect. We allude to the Essays on the Poetry of Architecture, by Kata Phusin. These essays will afford little pleasure to the mere builder, or to

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cold air which enters the room and passes near the floor to the stove, ascends through the open, central cavity of the radiator, and is diffused in a warm state over the room.

Much has been said recently in the British journals, of Joyce's patent stove, elegant in its appearance, and mysterious in its operation to all that have not been informed of the secret. It may stand anywhere in the room, and is quite unconnected with any chimney, flue, or pipe, and will give out its heat for six hours without any renovation or disturbance. All the gases that arise from the combustion are of course thrown into the room. Of the fact of its containing fire and answering the common heating purpose of a stove there is no dispute; but whether any thing deleterious to health issues from it, is a question on which the Doctors have pointedly disagreed. It appears now from the publication of the patent, that the fuel is prepared charcoal,—"prepared" by wetting or saturating it with carbonate of soda, and reburning or heating it to redness before using it. The alleged advantage of this process is that the carbonic acid proceeding from the combustion of the coal, will be absorbed by the alkali as it is formed, and thus be prevented from escaping into the room. Whether such a consequence does ensue or not is a question of vital importance as respects the safety of the stove. Gay Lussac examined some of Joyce's prepared charcoal and could find little or no difference in the amount of carbonic acid disengaged between this and equal weights of good common charcoal formed from light woods. Moreover, we perceive from the December Number of the London Mechanic's Magazine, that a man who was appointed to watch the operation of a new Joyce's stove placed in the centre aisle of St. Michael's church, London, on the 17th November, between 4 and 5 o'clock in the afternoon, was found between 6 and 7 o'clock next morning lying on his face about a yard and a half from the stove, quite dead. Four surgeons were of opinion that the man died of apoplexy. Others thought he had been suffocated by the noxious gases from the stove.

It is probable that this stove, with its prepared charcoal, may still be extensively called for and used in open rooms during the day, without any immediate, perceptible injury from its gases, and as it is considered to afford the *ne plus ultra* of economy, giving out into the room, absolutely, all the heat that the fuel produces, it will still maintain its claims to the patronage of the public.

By the advertisement of William Harper, the sole proprietor of Joyce's stove, we find that a stove adapted to a room 18 feet square will consume only nine pence worth of fuel per 24 hours. Now let us compare this with Olmsted's stove. From the trials recorded in our journal, Vol. xxi., p. 248, it appears that a ton of anthracite coal would be sufficient for the winter, at an average of the external thermometer of 32°, or a ton and a half when the average was 20°, and this for a room of the same size, viz. 18 feet square. Taking the highest estimate, a ton and a half, and supposing this to cost 10 dollars, (a high price for nut coal in Philadelphia,) if we divide this by 150 days, the quotient is $6\frac{2}{3}$ cents, instead of $16\frac{2}{3}$ cents, the acknowledged daily expense of Joyce's stove. Hence, if anthracite coal can be obtained in London as cheap as in Philadelphia, (and as it is abundant in Wales, we doubt not that it can) it is obvious that the cost of heating by Olmsted's stove would be less than one third of the vaunted cheapness of Joyce's patent, for the temperature registered in the trials above cited, was 5 or 6° higher than that which Harper's advertisement promises to secure. The anthracite stoves, as well as Joyce's, will, when arranged for the purpose, burn 24 hours without replenishing; but we should not presume to recommend its application apart from the use of a chimney or other outlet for the gases.

We have introduced this note from a belief that the matters which it embraces would not be uninteresting to our readers. G.

the architect who has no principle of guidance but precedent; but for such readers they were never intended. They are addressed to the young and unprejudiced artist; and their great object is to induce him to think and to exercise his reason. The great bane of modern architecture is, the tendency of all architects to be ruled by precedent. The evil is, perhaps, equally great in all arts of long standing, such as those of agriculture, legislature, &c.; and it will be proportionably difficult to root out. One of the first steps to this desirable end will be, a better general education for all young men whatever; and the avoiding, by parents and guardians, of inducing young men to follow any branch of the fine arts which they do not evince a decided taste for before they leave school. At present, young men are articled to an architect much in the same manner as they are apprenticed to any mechanical trade. The question is, not whether they are suited for that profession, but whether the income that profession may be expected to afford is suitable for them. In addition to this, the prejudice in favour of ancient architecture, whether classical or Gothic, must be given up, or, at all events, diminished; and, while all the forms and details left us by those who have gone before are free to be used, the combinations in which they are employed must depend for their beauty and effect on intrinsic properties, and not on their having been used in the same combinations before, or on associations connected with them, whether classical or otherwise, which have no connexion with their present use. One of our correspondents, who is at once an architect in extensive employ, and an excellent writer on his art, observes, p. 498. that one cause of the servile system in modern architecture may be traced to the deference paid to the celebrated *Treatise of Vitruvius.* "Had his [Vitruvius'] MS. been burned," he observes, "before it had been discovered by Poggio, the world would have been no loser; and, certainly, modern architecture would have been a great gainer." There are few architects, we are afraid, who will coincide with our correspondent in this opinion; but we do most heartily. Nevertheless, there are some, we trust, of the rising generation, who are able to free themselves from the trammels and architectural bigotry of Vitruvius and his followers; and it is to such alone that we look forward for any real improvement in architecture as an art of design and taste.

Arch. Mag.

*Mr. Pritchard's "Microscopic Illustrations."**

The microscope is of about the same antiquity as the telescope; but until within the last twelve years it remained an instrument of comparatively small utility. The achromatic principle which was at once adapted to the telescope with astonishing success, was productive of no such happy results on its first application to the microscope. Swammerdam, Lewenhoek, De Torre, Euler, and others, applied themselves with great industry to the discovery of some means of remedying the defects of spherical and chromatic aberration to which the simple microscope is subject, but missed the way to the object of which they were in search, by assuming it for granted that the smaller the angle of aperture the better. To such an extent was this notion pushed, that Lewenhoek had lenses with a focal length of not more than 1-700th or 1-800th part of an inch. To the acute, lively, and enthusiastic Dr. Goring it was reserved to discover, in 1827, that the road t perfection lay quite in the opposite extreme—that on the number of rays of light which can be collected by the object lens from every point on the surface of the objects examined, depends the efficiency of the microscope. And thus, to use the words of Dr. Brewster, it has "become quite a new instrument; and promises to be the means of disclosing the structure and laws of matter, and of making as important discoveries in the infinitely minute world, as the telescope has done in that which is infinitely distant."

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* New edition, emended and enlarged. 1838. 248 pp. 8vo., with numerous plate Wittaker & Co.

Dr. Goring's ablest fellow-labourer has undoubtedly been Mr. Pritchard, whose numerous contributions to microscopic science, both instrumental and literary, we have, more than once, had occasion to notice with commendation in our pages. The volume now before us is an "emended (Query *a*mended?) and enlarged edition" of a work under the same title, which appeared in 1829, and helped greatly to make the value of Dr. Goring's discovery known to, and duly appreciated by, the scientific public; but it is an edition *so much* amended and improved as to be, in fact, almost an entirely new work.

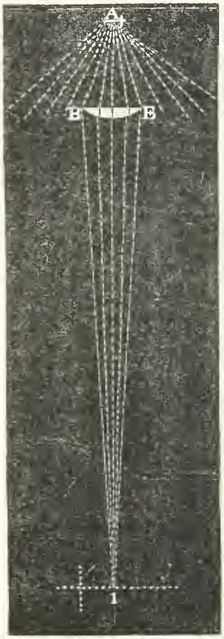

Fig. 1.

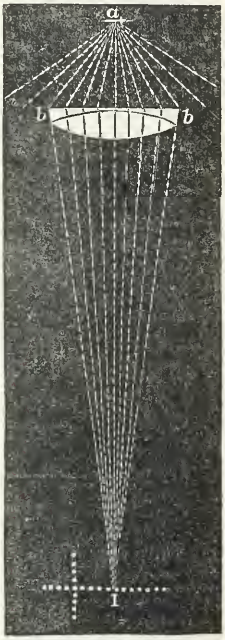

Fig. 2.

As many persons—not unlearned even—have been heard to express themselves at a loss to understand how it is that an increase in the length of aperture is so efficacious, we shall take this opportunity of extracting the very satisfactory statement of *the sufficient reason* here given by Mr. Pritchard:—

"Every one who has considered the subject at all, will understand that by a series of glasses of different media, aberrations, &c. may be corrected, and almost entirely dismissed; but it is not so readily perceived how a compound microscope, having a series of glasses, can, with less illumination, give a brighter and more vivid picture, with more of the detail or minute structure of an object, than can be obtained with greater illumination, by a single lens. In this particular, however, consists the main advantage of an achromatic.

"Let me premise that, in order to render any object visible, it is necessary that rays of light should proceed from it, either by reflection from its surface, or by transmission through it, to the eye. Again, if the number of rays be insufficient, the object cannot be seen, notwithstanding we employ a microscope for the purpose. Bearing this in mind, I will endeavour to explain how an increase of angular aperture in an object-glass, independent of any increase of its magnifying power, will admit a greater quantity of light from any given point on the surface of an object to pass through the lens, so as to render the structure of the object visible.

"Let A and *a* represent two objects, in all respects alike, and let us employ two microscopes, of equal magnifying powers, for the purpose of viewing them. Suppose that we are going to look at some spot on the surface of A, or *a*, which we will imagine to be a delicate tissue. By a well-known law of light, the rays proceed in right lines, in all directions, from this spot, in the manner shown by the dotted lines in both figures. Suppose B B, and *b b* to be two object-glasses, of equal focal lengths; the former a single lens, of the best construction, such as was used in the old compound microscope, and the latter a lens of the newest form, termed an achromatic. Now, these object-glasses will form their respective images at I, and *i*, and they will be of equal dimensions. But if the number of rays proceeding from A, and falling upon the single lens B B, is not enough, when collected at I, sufficiently to stimulate the eye, any minute pore, striæ, or other marking at A, will not be rendered visible; whilst, from the increase of aperture in the achromatic lens, *b b*, allowing much more light from *a* to fall upon it, and to be transmitted through it and collected at *i*, every marking, &c. at *a*, will be clearly represented at *i*; and the eye, being powerfully acted upon by this increase of light, will become highly sensible of it.

"The angles B A B, and *b a b*, are the angles of aperture of the respective object-glasses; and the quantity of light collected and transmitted by each will be as the squares of B B, and *b b*, the focal lengths being equal. Hence it is that the power of a microscope, or that faculty it possesses to render the structure of an object visible, depends upon the angle of aperture of its object-glass, and not upon its magnifying power alone.

"But it may be supposed, perhaps, from this reasoning, that if we throw a greater quantity of light upon an object, so that more may be collected by the object-glass, we shall be the better able to define its structure; which would probably be the case if the additional light could be thrown only upon those minute parts which we wish to examine, and not upon the whole object. But as we cannot do this—as the increase of illumination cannot be made to increase the *relative proportions* of light which proceed from these minute parts, the intended advantage will not be derived."

Mr. Pritchard mentions a curious "case in point," to show the obstinacy of the ignorance which still prevails, among optical instrument-makers, with respect to the necessity of applying the achromatic principle to the microscope as well as the telescope:—

"I have in my possession, at this moment, a triple object-glass, evidently made in imitation of one of Mr. Tulley's achromatics. In constructing it, however, the optician, a person of great respectability, was so unacquainted with what an achromatic is designed to effect, that he actually placed a stop behind the lenses; so that, notwithstanding the folal length does not exceed half an inch, an angle of aperture of only 7 degrees is obtained. This object-glass, of course, is inferior to a common lens: and hence has originated the erroneous notion that the introduction of achromatics has been no improvement to microscopes."

Every one who has a taste for microscopic investigation, and is desirous of having the best instruments for the purpose, would do well to apply, in future, to Mr. Pritchard himself,* whose improved microscopes and appendages are even better than his books upon them. It is a fact here worthy of particular record, that the *Microscope-goniometer*, invented by Mr. Pritchard to measure the angle of aperture of microscopic object-glasses, has been found of such universal utility that it has been not only employed for reading off the divisions in the trigonometrical survey of Ireland, now in progress, but has been since used by astronomers for similar purposes, in the microscopes attached to transit circles; the advantage of which is, that observations can be read off much longer in the twilight of an evening without artificial illumination—thus causing less fatigue to the eye than is experienced by looking alternately "at objects illuminated by different coloured lights."

Much stronger proofs, however, of the beneficial effects produced on science in general by the new stride made in microscopic instrumentation through the discovery of Dr. Goring, and its successful applications by Mr. Pritchard, and other less distinguished followers, remain behind.

The following passages from Mr. Pritchard's "Introductory Remarks" to his present volume are extremely striking. They presented much that was new to us; and will be found, we doubt not, to contain much that is equally new to the majority of our readers:—

"The fact is, that since the modern improvements the miscroscope has undergone, it is being brought to the assistance, and is at the present time furthering the progress, of almost every branch of natural science. To the Geologist it may be said to be a new instrument. But what has it not even now effected for him? In his study of organic life and structure, it has unfolded to him the precise characters of divers animals and plants which inhabited and cloathed our earth in ages which have long passed away. Look at the discoveries of Agassiz on the fossil creatures of the deep! By a microscopic investigation of such portions of them as have withstood the destructive power of time, namely, their scaly covering, he has been able so to group and class them, that the characters and habits of the genera belonging to each distinct era are clearly demonstrated. A microscopic examination also of the testaceous remains of sundry Entomostraceans found in slate-clay formations, now elevated much above the level of the sea, prove them to have been at some time or other imbedded in the waters. And the Naturalist may even determine by his inspection of the shell, whether the species were the inhabitants of fresh or of salt water, and consequently whether the strata themselves were the indurated beds of the sea, or of some river or lake.

"The *most perfect* animal remains which the microscope has disclosed to us, are the various loricated Infusoria of the division Bacillaria.† These minute creatures are so inconceivably numerous that they cover many miles of surface with several feet of thickness; as instanced in the polishing-slate and rotten-stone of Bohemia. In Tuscany, whole mountains consist almost entirely of the silicified shells of these creatures; thus combining with each other in infinite numbers, to counterbalance, as it were, their individual minuteness, and to teach the unthinking this useful lesson, that Nature in all her operations, is never employed in vain, and that, what are apparently her most insignificant productions, fall not beneath the notice of the profoundest inquirer after truth.

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* 162 Fleet Street.

† See Mr. Pritchard's Natural History of Animalcules, p. 59.

"To the botanist, the aid of the microscope is indispensible. In the investigation of our fossil-flora, what does it not exhibit to us! How beautiful and delicate is the structure of the envelope of some of the fossil-fruits; those, for instance, of our London clay, when viewed under this instrument; and how important is it, that, by its assistance, we can determine with accuracy the natural orders, genera, and sometimes the very species of the trees and plants of former epochs! How, beyond all question, is now demonstrated the vegetable origin of our coal! Preserved within a bituminous lump of coal, which has been deposited for thousands of years deep in the bowels of the earth, you may discern not only the wooden fibre, its arrangement, and the disposal and form of the medullary rays, but even the most delicate of the vegetable organs, such as the spiral vessels, and the beautiful termination of these vessels! These are as distinctly discoverable as in the finest preparations of a recent plant. And what can be more amusing and instructive than the examination of the silicified woods, when formed into sections no thicker than the paper of a bank-note? Thus rendered pervious to light, the organic structure of the wood becomes plainly distinguishable. And emanating from this, what can be a more interesting subject than the inquiry into the mode in which the silicifying process has been carried on—by which the constituent elements of the inmost and minutest portions are changed—whilst their form and situation and colour remain the same? In investigating also that extinct genus of plants, the Lepidodendra, a similar idea is raised in the mind, as to what must have been the particular state of the earth with respect to atmosphere and temperature at the period of their growth, and what the changes which have since taken place, in order to bring it to its present condition.

"In our physiological inquiries into the animal and vegetable productions of the present time, the assistance of the microscope is essentially requisite. When Dr. Harvey made his grand discovery of the circulation of the blood, and first lectured upon it, in St. Bartholomew's Hospital, in 1619, he was ridiculed, and lost his practice, through maintaining what was then supposed to be so absurd and wild a theory. The idea was suggested to his mind by reflecting on the valves of the heart and veins, which were evidently so planned as to allow a fluid to pass but one way. All the philosophical reasoning, however, of this celebrated man, could not establish, what appears to us so plain a truth, until it was evidenced in the circulation of cold-blooded animals, by means of the microscope, and thus placed beyond a doubt. Discerning, as we can do, the very forms of the globules of that fluid, as they flow through the capillaries from the arteries to the veins, in obedience to the laws impressed upon them by the Almighty Creator—viewing this most sublime phenomenon, by which life itself is diffused throughout, and sustained in every part of the system—who can resist conviction of the great truth?

"Nor is it a matter of less importance in a scientific point of view, or less interesting, that by the same means we can perceive the fibrous structure of the muscles and nerves, the form and arrangement of the canals by which the internal cavities of the bones are lubricated and nourished, the glandular structure of that beautiful and complex apparatus by which the secretions* are carried on—all, and each of these, requiring but the aid of one of our improved microscopes to render them distinctly visible. Again: how admirably developed, by means of the microscope, are the curious and complex structure of the eyes of insects, the crystalline lenses of those of fish, birds, &c.†, and many of the other parts of the visual organs.‡ The eye—that useful and delightful portion of us which furnishes all the endless variety of objects from which we derive so great enjoyment—resembles, in its peculiar formation and arrangement, an achromatic optical instrument. And if we descend to the lower classes of animals—nay, I would hardly say lower, lest some, perhaps, might imagine that in their small forms they do not evince as much perfection as is discoverable in beings of a higher scale, and have not all the functions which are necessary to life as full in operation as even man himself—if we enter upon an investigation of their minute structures, we can determine absolutely nothing without the microscope; and our knowledge of the very existence of many highly-organized and active creatures is wholly dependent upon it.

"Vegetable organography, upon which the modern botanist depends so much for his systematic arrangement, and with which the student is so greatly interested and amused, owes almost its very existence to the microscope. This observation will be found to apply in an especial manner both to the cellular and vascular tissues of plants. The membraneous cellules of cellular tissue are sometimes not more than 1-1000th of an inch in diameter; and those of the ordinary size are about 1-200th or 1-300th. How, then, is it possible that we could become acquainted with their forms and arrangement, but by the aid of the microscope? And so with respect to vascular tissue: it is absolutely indispensable toward acquiring an accurate knowledge of the structure and forms of these membraneous tubes, and of the spiral or annular fibres which surround them.

"A knowledge of the fructification, if I may so express myself, of that numerous and curious class of plants, the Acrogens, could not be obtained without it; nor could the existence of many of them, such as the Fungi, Lichens, Algæ, and some of the Musci, be proved. By its powers, even the ashes of vegetables may be seen to contain the decisive characteristics of organic structure; and the long-debated question of the antiquarian, as to whether the 'fine linen of Egypt,' in the times of the Pharaohs, were of linen or cotton fibre, seeing the latter is now indigenous to that country, is for ever set at rest.

"In many of the larger portions of plants, such as the cuticle of their leaves, the stomata, &c., which require but a shallow magnifying power to display them, there is as great a difference manifested when these are viewed under an achromatic microscope, or under the old compound, as is perceptible between the most highly-finished miniature, where the most delicate features and even the down on the skin are correctly depicted, and the mere black and white profile, where we see but the rude contour of the face. Surely, then, as works of art merely, instruments which can effect so much as this are justly entitled to a due share of consideration, even from the most refined and polished minds."

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* Nouvelles Recherches sur la Structure de la Peau, par M. Breschet.

† Philosophical Transactions, 1833.

‡ See Langenbeck on the Eye.

Again:—

"In the study of crystallography, which science may be said to have been for a long time almost at a stand-still, a very extensive field of research appears to be now opening, by the adaptation of polarized light to a microscopic examination of minute crystals—thus eliciting a great variety of curious and beautiful properties, entirely unknown to the world before. This subject being as yet completely in its infancy, it would be unfair to expect an elucidation of it at the present time. To convey, however, some general idea to the reader, of the additional degree of interest which attaches to the phenomena of crystallization by this happy contrivance, it is only necessary to state, that we have now displayed to us minute crystals, with a brilliancy and richness of colouring that is quite inconceivable. We see the smallest difference in their thickness marked by some exquisite change of colour; whilst the beautiful black cross in the circularly arranged crystals of zanthate of ammonia, and the cross with the coloured rings in the compound of phosphoric acid and borate of soda, &c. &c., excite our admiration beyond all bounds. These newly discovered phenomena, after a patient investigation, may lead to results highly interesting, and of great importance to science." Mec. Mag.

On the Erection of Buildings in Unhealthy Situations.

Those who have studied the nature of soils and situations, with reference to their influence on health, cannot but feel surprised at the building projects which are occasionally made public by architects and building speculators. It would be uncharitable to suppose that these architects and builders are fully aware of the danger, as regards health, of living in such situations as those which they propose to cover with human habitations; and it is clear that the great body of house-renters know very little of what is best for them, in point of situation and soil, or speculative builders would never risk their property in covering such situations with masses of buildings. We have been led to these remarks from having seen a lithographed plan for covering a piece of ground, of about sixty acres, we believe, in extent, between Notting Hill, and Shepherd's Bush, with streets, squares, and crescents, of what we suppose will be reckoned second and third-rate houses. The soil is a strong clay; the situations, for the greater part, quite flat; and the whole is so moist, that three or four years ago, when this ground was proposed to be turned into a cemetery, the wetness of the soil, and the want of drainage, were found to be insuperable objections. But, even supposing that there were sufficient drainage, the lowness of the situation, and the retentive nature of the soil, are such as to render the piece of ground altogether unfit for the erection of human habitations, in our present state of civilization, and comparative delicacy of constitution. We have no hesitation in saying, that there is not a spot in the whole of this sixty acres, on which we should willingly set ourselves down, even if we had the ground and the house-rent free. A respectable builder, we are told, being asked to take a portion of the ground, honestly replied, that he would never undertake to build a house in which he would not be willing to live himself, if necessary. Unfortunately, few architects or builders ever think at all of the healthiness or unhealthiness of the situation of the houses they are employed to build. All they think of is, to make a convenient plan, and to design a handsome elevation; while the object of the proprietor is, to increase the value of his land, by covering it with houses. The tenant, allured by a showy exterior, thinks as little of the subject as the proprietor and architect have done, and only finds out his danger when it is too late to save himself without considerable pecuniary loss. What, then, is to be done to secure the public against buildings placed in unhealthy situations? Are we to have a metropolitan board or commission; or some public officer appointed to superintend these things? Or, should a survey be made, by order of government, of the suburbs of the metropolis, and of all large towns, and those places pointed out on a map which are fit for building, and also those which are unfit? Something, no doubt, might be done by having a commission, or a public officer, to refer to; but the grand remedy for every evil of this kind is, as it is for most others, the spread of knowledge; and, in this case, the general enlightenment of the public, with regard to the requisites for insuring health, is the kind of knowledge wanting. This can only be acquired effectually in youth; and the time will, no doubt, come, when it will be made a part of every one's education. In the meantime, the public must suffer, and gain knowledge by experience; unless they should be so fortunate as to meet with such books as *Combe's Constitution of Man*, *Clark on Climate*, *M'Culloch on Malaria*, and others, which treat expressly of the healthiness and unhealthiness of soils and situations.

Ibid.

Mechanics' Register.

New Material for Sheathing Ships' Bottoms.

A few years ago, a patent was obtained for a metal, wherewith to cover the bottoms of vessels, and which promised all the advantages of copper, with at least equal durability in any climate, and a considerable saving in cost. It consists of an amalgamation of metals, copper itself being the principal, and zinc probably (for we are not in the secret) forming one of the ingredients. It is manufactured in sheets in the same manner as copper, and from its resemblance to yellowish tinted brass, has obtained the name of "yellow metal." Several vessels belonging to this port, and others of London, were plated with it some years ago; but it was found to be less ductile than copper, and therefore less suitable for being laid round angles, or into the grooves or hollows of the stern-post or rudder, where the rudder irons (or rather coppers) are attached. In some instances, too, when it required renewing, it was found, on taking it off, that it had, to a considerable degree, perished, having become so brittle, and full of minute pores, that, to use the word of a seamen, who examined it, "it broke in the fingers like a piece of gingerbread." This was, however, in the comparative infancy of the invention, and before proper proportions of materials, of which the metal was composed, had been proved by the test of experience; and the friend of science and of commerce will, doubtless, be gratified to learn that such improvements have since been made, as will, in all probability, ere long, render the use of the "yellow metal" almost universal in our mercantile marine, as at once combining economy with durability. The metal is now made sufficiently ductile for sheathing; several fine large ships have been bottomed with it within the last few months, and it is so rapidly gaining ground in the estimation of navigators, that we are informed Messrs. Pascoe Grenfell, and Sons, copper dealers, have, during the last half year, done much more business in the article than in copper itself. The captains who have lately given it a trial, speak highly of its good qualities; and one vessel plated with it has made three successive voyages from London to

India without requiring any renewal in that particular—showing a durability considerably beyond the copper generally used. The price is 1½d. per lb. cheaper than copper, and it is 6½ per cent. lighter than that metal. It is also found to retain its weight to a greater extent, and the old metal is taken back in exchange by the manufacturers. Another, and perhaps an equally important, use of this metal is, for the bolts or fastenings of ships. From its hardness, when manufactured for this purpose, it is vastly superior to copper, inasmuch as being nearly as hard as iron, it can be driven into a much smaller augur-hole than copper, and to a greater depth in dead wood; forming, consequently, a tighter and stronger fastening, and not so liable to draw, on this account, as well as from the absence of verdegris. From all, indeed, that we can learn, the "yellow metal" may be considered one of the most useful discoveries of modern times in a commercial country like this.

The works are situated within about a mile of the town of Swansea, immediately in the neighbourhood of the copper works (on which we shall have occasion to say something in an early number), and are at present capable of manufacturing a considerable quantity of sheathing and bolts—there being four pair of rollers, with the machinery necessary for drawing rods, worked by an engine of 54½-inch cylinder, 8½-feet stroke. The metal is a combination of copper and zinc, the best admixture being found to be 60 per cent. of the former and 40 per cent. of the latter. The metal is delivered on the works, and is then submitted in these proportions to the action of a reverberatory furnace, or melted in pots, from which it is cast in plates or bars, according to the object for which the metal is required, whether "bolts" or "sheathing." It is subsequently submitted to heat, and when, as it appeared to us, of a "cherry red," is worked in the cylinders or rollers, or drawn out in rods. The process is in itself exceedingly simple, and affords little novelty to any one accustomed to the manufacture of iron.

Many opinions have been advanced, and doubts expressed, of the advantages (if any) which this metal possessed, while its ductility was questioned, and its permanence only admitted when it had been subjected to the test of some years' application.

It is satisfactory to find that the results have fully realized the sanguine expectations of the patentee; one vessel having made three voyages to India without repairs being required, and another having been sheathed for the past five years with the "yellow metal," and now in good condition, while in the port of Swansea, at the present time, two Hamburgh vessels, the *Kate* and *Anna Louise*, have adopted it. In the instance of the *Kate*, we take the words of the owner, "he has effected a saving on a 400 ton vessel of full 80*l*.;" the difference in the price of copper and Muntz's (or yellow metal) sheathing, being three-halfpence per pound less, and the difference in the specific gravity 8 to 9 per cent. With respect to the bolts, we have it on the statements of the shipwrights employed, that they are far superior in driving to those of copper, as possessing more tenacity and firmness. Such are the advantages of the combination of the two metals—copper and zinc; and we may, therefore, hope, that with these advances in metallurgical science, we shall, whatever may the be influx of copper ores from foreign climes, be able still to look to home for our supply of mineral, which shall furnish not only employment to the population in our mining districts, but yield, as it has heretofore done, so considerable a proportion of our national wealth.

Lond. Min. Jour.

Statue of James Watt in Greenock.

The statue of James Watt, by Sir Francis Chantrey, is now placed in the building erected for it in Union street. It is an 8 feet figure, of statuary marble, and weighs upwards of 2 tons, and the pedestal, which is of Sicilian marble, weighs about 3 tons. On the front of the pedestal is the following inscription, from the classic pen of Lord Jeffrey:—"The inhabitants of Greenock have erected this statue of James Watt, not to extend a fame already identified with the miracles of steam, but to testify the pride and reverence with which he is remembered in the place of his nativity, and their deep sense of the great benefits his genius has conferred on mankind. Born XIX January, MDCCXXXVI. Died at Heathfield, in Staffordshire, August XXV., MDCCCXIX." On the right of the pedestal is a shield containing the Arms of Greenock, and on the left, strength and speed. On the back is an elephant, in obvious allusion to the beautiful parallel drawn by Mr. Jeffrey between the steam-engine and the trunk of that animal, which was equally qualified to lift a pin or to rend an oak. Mec. Mag.

Anderson's Steam Carriage.

The steam carriage, or drag, invented by Sir James Anderson, is entirely built of iron, except the wheels, which are of great strength and durability. The frame is perfectly unpliable, though very light, and the axle-tree springs so arranged, that any inequality, or ruts, in the road can have no injurious effect. It is lower and shorter than the stage-coaches, but broader, in order to prevent any possibility of upset; and, although made of iron, the weight leaves no greater track on the road than other carriages—and the face of the wheels being six inches broad, it is expected that they will act as rollers, harden the surface, and not cut into it, as is the case with narrow wheels. The cylinders, or engines, which drive the carriage are twelve inches in diameter, the stroke twelve inches, and the heating surface of the boiler is about 500 feet. The power at all times available is fully equal to sixty-three horses; and the consumption of fuel is so small, that about 2d. per mile will cover the expense. The engine, when at work, burns about a hundred weight of coke per hour. The passenger carriage is to be attached to the drag, and contains room for from thirty to forty persons. It has been built in Dublin, and will be forwarded to London with the drag, after a public trial has been made of both in Dublin. Lond. Min. Journ.

Gas-Light.

The earliest application of this artificial light, on a large, systematic scale, was made at Manchester; where an apparatus for lighting the great cotton mills of Messrs. Phillips and Lee, was fitted up in 1804 and 1805 under the direction of Mr. Murdoch. A quantity of light, nearly equal to 3000 candles, was produced and distributed in this building. This splendid pattern has been since followed very generally in Great Britain, and more or less in many parts of the continents of Europe and America. By the year 1822 gas-lighting in London had become the business of many public companies. In 1822 there were four great companies, having in all forty-seven gasometers at work, capable of containing 917,940 cubic feet of gas, supplied by 1315 retorts, which generated per annum upwards of 397,000,000 cubic feet of gas, by which 61,203 private lamps, and 7268 public or street lamps, were lighted in the metropolis. Besides these public companies, there were likewise several private ones. Dr. Ure's Dic. of Arts. Ibid.

Safety of Bonds, Bills, &c.

A large banking-house, which has recently been finished in the first style of architecture, consequent upon the improvements in the city, had an immense pit or well dug many feet below the surface, and made water-proof by substantial brickwork. The mouth of the pit opens in the floor of the bank parlour, but, during the hours of business, is effectually covered by the oaken floor. At the close of the day, and in the presence of the responsible parties, the bank books, bonds, bills, notes, security and specie, enclosed in proper receptacles, are placed on the trap over the orifice of the well, and, by the aid of ingeniously contrived machinery, the property is lowered to the bottom, a depth of about 40 feet, the trap-door is secured, and at the opening of the bank in the morning, the property is again raised to suit the purposes of the day. Lond. Morn. Chron. Arch. Mag.

Mr. Crosse's Electrical Experiments.

Tuesday week Mr. Andrew Crosse delivered a lecture on atmospheric electricity, at Taunton, illustrated by a number of beautiful experiments. He illuminated 400 feet of iron chain, hung in festoons about the room, the whole extent being brilliantly lighted at the same instant by the passage through it of the spark from the battery, and melted several feet of wire. Mr. Crosse afterwards detailed the results of many experiments on thunder clouds and mists. By means of a wire apparatus suspended in his park, he had discovered that a driving fog sweeps in masses, alternately, negatively and positively electrified; and once the accumulation of the electric fluid in a fog was so great, that there was an incessant stream from his conductor of sparks, each one of which would have struck an elephant dead in an instant. Lond. Times. Lond. Mech. Mag.

Cement for Paper.

A mode of joining sheets of paper together, was exhibited by Mr. Cooper by which the puckering that is occasioned by paste or glue, or any watery solution, is avoided, and a very neat joint is produced. The cement used is a thick solution of caoutchouc, which being applied to the edges of the paper, is allowed a little time to dry and get sticky before the sheets are joined together. This expedient will be found very useful to the lecturer and the draftsman. Royal Inst. Ibid.

Photogenic Drawing.

Considering that any (however trifling) improvement will not be unacceptable to those of your readers who feel an interest in this art, I have been induced to communicate the following method of preparing the paper, which, after many experiments, I find to succeed best. Wash the paper with a mixture of equal parts of the *white of egg* and *water*, afterwards with the solution of nitrate of silver, fixing the drawing as usual with the iodide of potassium.—H. L. Athenœum. Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, SEPTEMBER, 1839.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
14	6	21	Im. τ Scorpii	3.4	80°	98°
14	7	48	Em.		267	301
20	12	25	Im. 42 Aquarii	6	123	151
20	13	32	Em.		311	350
23	8	5	Im. 60 Piscium	6	147	98
23	9	0	Em.		281	235
26	9	44	Im. g Pleiadum	5.6	125	283
26	10	38	Em.		71	227
26	9	41	Im. b "	4.5	89	35
26	10	31	Em.		319	263
26	10	6	Im. e "	5	154	253
26	10	48	Em.		98	197
26	10	8	Im. c "	5	122	66
26	11	5	Em.		288	231
29	17	15	Im. 47 Geminorum	6	63	18
29	18	36	Em.		275	285

Meteorological Observations for March, 1839.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
				Inch's	Inch's			Inches.	
	1	36	37	29.80	29.80	W.	Brisk.		Partially cloudy—clear.
	2	35	57	29 70	29.65	W.S.W.	do.		Clear—cloudy.
	3	24	24	29.70	29.85	N.W.	do.		Flurry of snow—clear.
	4	11	23	30.25	30.25	W.	Moderate.		Clear—do.
	5	19	40	30.15	30.10	W.	Brisk.		Clear—do.
	6	27	47	30.25	30.20	W.	Moderate.		Clear—do.
	7	61	55	29.96	29.85	S.W.	do.		Partially cloudy—hazy.
☽	8	34	53	29.50	29.40	S.E.	do.	.19	Cloudy—rain.
	9	38	49	29.50	29 50	W.	Brisk.		Cloudy—do.
	10	30	34	29 84	29.84	W.	do.		Clear—do.
	11	22	36	29 94	29 94	W.	do.		Clear—do.
	12	24	43	30.00	30.15	S.W.	Moderate		Clear—do.
	13	28	52	30.30	30.25	S.W.	do.		Clear—do.
	14	26	46	30.20	30.25	S.W.	do.		Clear—do.
⊗	15	32	52	30.10	30.00	S.E.S.	do.		Cloudy—clear.
	16	36	48	30.00	30.00	S W.	do.		Clear—do.
	17	42	53	30.00	30.00	S.E S.W.	do.		Cloudy—lightly do.
	18	42	70	29.90	29.80	S.E.	do.		Cloudy—hazy.
	19	48	52	29.65	29.81	W.N.E.	do.		Cloudy—do.
	20	36	34	30.10	30.15	E.	do.		Cloudy—rain.
	21	36	43	29 90	29.80	E.	do.	.55	Rain—drizzle.
☾	22	35	52	29.70	29 70	W.	do.		Foggy—clear.
	23	42	48	29 65	29.60	N.E.	do.		Cloudy—do.
	24	32	48	29.80	29.85	W.	do.		Clear—do.
	25	34	40	29.65	29.80	N.W.	Brisk.	.09	Snow—flying clouds.
	26	29	51	30.00	29 96	W.	do.		Clear—do.
	27	43	68	29.75	29.75	W.	do.		Lightly cloudy—clear.
☉	28	50	75	29 80	29 85	S.W.	Moderate.		Clear—hazy.
	29	52	74	29.80	29.75	S.	Brisk.		Cloudy—flying clouds.
	30	43	42	29.86	30.10	W.	do.	.02	Rain—flying clouds.
	31	30	47	30.04	30.45	E.	do.		Clear—do.
	Mean	33.81	48.16	29 90	29.92			.85	

	Thermometer.	Barometer.
Maximum height during the month.	75. on 28th.	30.45 on 31st.
Minimum " " "	11. 4th.	29.40 8th.
Mean	35.985	29.91

ERRATA.—The Table of Lunar Occultations in the last number was, by error of the press, marked for July instead of August.

Page 7, line 12, of the present number, for *carbonic acid* read *ammonia.*

Lines 32, 33, and 34, on the same page,—the sentence is improperly divided and punctuated: it should read—*Since by its conversion into carbonic acid, oxygen undergoes no change of volume, fifteen measures out of the thirty five were to be ascribed to oxygen consumed by hydrogen.*

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

AUGUST, 1839.

Practical and Theoretical Mechanics and Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Examination of some of the Anthracites found in Sugar Loaf Township, Luzerne County, Pennsylvania. By PROFESSOR W. R. JOHNSON.

The value, for economical purposes, of careful examinations of mineral fuel must be apparent when we consider the multifarious uses to which such fuel is already applied, and the certainty that far greater extension must ere long be given to it, especially in the application of anthracite to various manufactures of iron and other metals, to locomotion on land, and to steam navigation on the ocean. To subserve these different purposes, various qualities are required in the fuel adopted, and the absence of noxious ingredients must be previously ascertained, in order to insure the applicability of any given variety of coal. I may observe that however extended may be the uses of anthracite, whether for domestic consumption, for locomotion, for the prosecution of the arts, or for commercial and naval steam navigation, Pennsylvania seems destined to supply the United States with this most important article of fuel. In this view of the subject I have devoted what leisure I could command for some years past, to inquiries relative to its various properties, and to the means of rendering it available in the several ways above referred to.

I should state that the site from which the samples were taken, is on the northern side of Hazle Creek Valley, at the base of Corneil Ridge, about two miles distant, in an easterly direction, from the mines of the Hazleton Coal Company, and about three fourths of a mile from the Rail Road of that Company, with which the Sugar Loaf Coal Company's mines are connected by a branch road.

The bed of coal conforms in *direction* with the general direction of the ridge, at the base of which it lies, and indeed of most of the parallel ridges in that section of the country, being about north 80 degrees east. Its inclination at the surface, or outcrop, is 32½ degrees, but within a few yards of the surface this is changed to 27½ degrees, which angle it maintains to the present depth of the slope, or about 250 feet. This degree of inclination gives to every acre of land measured on the *horizontal surface, one and one eighth* acres, as measured on the inclined surface of the coal bed.

The entire thickness of the carbonaceous deposit on which the present works of the company are established, including that of the slates intervening between the several seams of coal, is something more than thirty-one feet.

This is the result of measurements taken perpendicularly across the thickness of the beds in the vertical shaft sunk near the mouth of the slope, and now used as an air shaft. The several members of the series will be found to correspond very nearly to the following section beginning at the surface of the ground, viz.

	Feet.	Inches.
1. Earthy surface soil, ...	2	0
2. Decomposed carbonaceous matter or "black dirt,"	6	6
3. Coal with partings of slate, ...	8	0
4. Slate, ...	0	3
5. Good coal, ...	1	6
6. Bony coal, ...	1	1
7. Good coal, ...	2	0
8. Slate, ...	0	6
9. Good coal, ...	6	2
10. Bony coal, ...	1	5
11. Good coal, ...	4	1
	33	8

Besides this series, disclosed at the period of my visit, subsequent explorations have, I am informed, developed other beds both superior and inferior in the order of stratification, to that now worked.

Three specimens of the coal have been particularly examined.

No. 1 was from the pit above referred to, about thirty yards in advance of the opening at which the "slope," or inclined railway, is now carried down.

No. 2 was taken from the slope at about 100 feet from its mouth, and from the upper part of the ply of good coal, No. 9 of the above section.

No. 3 was from the bottom of the same ply, and about the same depth on the slope.

No. 1 is compact in structure, giving conchoidal fractures in all directions, apparently indifferent to the surfaces of deposition which are manifested only by alternating lines or seams of blueish black and jet black, which mark the successive layers. The appearance gives the idea that these surfaces have been in a great measure obliterated, while the whole mass was, from some cause, in a semifluid state. The specific gravity of this specimen is 1.591; consequently a cubic foot of it would weigh 99.46 pounds; and a cubic yard, 2694.81 pounds, or one and one fifth tons. Had the whole bed No. 9 of the section, 6 feet 2 inches thick, possessed the same specific gravity, there would, with the inclination above mentioned, be found 13,431 tons to the acre, horizontal measurement, and the whole deposit, if we include the layers No. 3, 5, 7, 9 and 11, being 21 feet 9 inches in thickness of *coal*, would give 47,375 tons per acre. This must, however, be taken with due allowance for pillars to the mine and waste in working, which will be greater or less according to the manner in which operations are conducted.

When heated to a temperature sufficient to expel the water which it contains, without decomposing it,

		Per Cent.
The specimen No. 1 lost		1.915
When the dried coal is ignited to redness for some time in a close vessel, it yields carbonic oxide and carburetted hydrogen, with a small portion of sulphur,		5.068
The remaining fixed carbon is		88.187
Earthy matter 4.83 per ct. viz.	Silica,	2.589
	Alumina,	1.772
	Peroxide of iron,	.270
	Lime,	.138
	Magnesia,	.052
	Protoxide of manganese,	.009
		100.

From the latter numbers it will be perceived that of the fixed ingredients or ashes of this coal, 100 parts will be composed of

Silica,	53.603
Alumina,	36.687
Perox. of iron,	5.590
Lime,	2.857
Magnesia,	1.076
Prot. manganese,	0.186

The ashes of this coal are of a yellowish white or very light buff colour, and very bulky.

Specimen No. 2 has a specific gravity of 1.574, from which it will be found that a cubic foot weighs 98.37 pounds, and the cubic yard 2663, or a trifle less than one and one fifth tons.

The colour and other external characters of this coal are similar to those of No. 1, but it was remarked that the surfaces of deposition are even more completely obliterated than in that specimen; and that in the direction of those surfaces, no even faces could be procured in fracturing the coal; while in planes at right angles to those surfaces, it has a " grain" or " sline" represented by exceedingly thin plates of white earthy matter, along which fractures frequently occur.

By heating to a temperature of 370° Fah. this coal loses		2.196	per ct.
By heating to whiteness in a close vessel, it gives of carbonic oxide and a little carburetted hydrogen,		3.165	"
The carbon not capable of being volatilized by simple heat, is		85.909	"
Its earthy impurities, including oxides, amount to 8.73 per ct. viz.	Silica,	3.938	"
	Alumina,	3.230	"
	Peroxide of iron,	1.135	"
	Lime,	.120	"
	Magnesia,	.120	"
	Loss,	.015	"
		100.00	

The proportions of the several ingredients of the ashes of this coal are somewhat different from those of No. 1. Thus the Silica is 45.105 per ct.

Alumina, . . .	37.000	"
Peroxide of iron, .	13.000	"
Lime, . . .	1.380	"
Magnesia, . .	2.430	"
Loss, . . .	1.085	"
	100.000	

The ashes are nearly white, or with a very slight tinge only of red, and are distinguished from those of No. 1 by a far greater *density*, being under a given bulk about two and a half times as heavy as the latter. A larger portion of oxide of iron and of magnesia will be observed in the second than in the first analysis. The above portion of peroxide of iron is equivalent to 9.1 per cent. of metallic iron; and if this circumstance were essentially important in the production of iron in the blast furnace, might lead to the inference that this coal would be more valuable than No. 1 for that manufacture, but the nearly double amount of earthy matter to be smelted, and especially the presence of a greater quantity of magnesia would render this at least doubtful. When this variety of anthracite shall be employed for smelting iron in the blast furnace, it will probably be found expedient to use in addition to the flux required by the iron ore, about 4 or 5 per cent of the weight of coal, in *limestone*, to reduce the cinder of the coal. At a temperature sufficient to smelt the iron ore of Beaver Meadow, this addition will be found to reduce to a porous cinder the ashes of the coal now under consideration.

Specimen No. 3 was taken from the bottom of the same bed (No. 9 of the section) as No. 2, and was found to have a specific gravity of 1.55, consequently one cubic foot of it will weigh 96.875 lbs., and one cubic yard 2615.625 lbs. or 1.167, say *one and one sixth* tons.

The colour of this coal is a deep and nearly uniform black—shining. Fracture irregular, splintery.

	Per Cent.
The water in this coal was found to be	2.250
Loss by heating for some time to whiteness, gas burning with blueish white light, ...	4.625
Carbon not volatile at a white heat, ...	90.705
Earthy ingredients 2.242 per ct. composed of	
Silica, ...	1.071
Alumina, ...	.965
Peroxide of iron, . . .	.135
Lime, ...	.141
Magnesia, ...	.073
Oxide of manganese, trace, .	
	99.965

It appears therefore that this is considerably richer in carbon than either of the other specimens, and that its earthy residuum is but little more than one fourth as great as that of No. 2.

The proportion of the several ingredients of the ashes it will be observed, is

Silica,	43.68
Alumina,	39.34
Peroxide of iron,	8.22
Lime,	5.76
Magnesia,	3.00
	100.00

This specimen has, therefore, both in the amount of its solid carbon and in the small proportion of its earthy residuum a considerable advantage over either of the preceding. Its specific gravity is also the lowest of the three. The density of its ashes is intermediate between that of 1 and 2 being exactly three fourths as great as the latter, so that the density of the residuum

of No. 1 is represented by 8
That of No. 3 by 15
That of No. 2 by 20

By an average of the three analyses above given, it will be seen that the

proportion of water in this coal, is	2.120	per cent.
The other volatile ingredients are	4.286	"
The earthy matter, oxides, &c.	5.326	"
Carbon,	88.268	"
	100.	

Hence the combustible matter, including the gaseous and solid materials, amounts to 92.552 per cent.

In conclusion, I may observe, that while these analyses demonstrate the high density and compactness of this coal, fitting it for the purposes of steam navigation, for which these qualities, combined with great heating power, are of primary importance; they also show that for the various arts and for domestic consumption its properties are calculated to sustain the high character of the central coal field of Pennsylvania, for the solid and durable heat which it furnishes, and the absence of those ingredients which might interfere with its useful application.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Warming of Rooms by heated Air. By Wm. Gries, M. D.

Womelsdorf, Berks county, Penn., July 12th, 1839.

Having been placed, some years ago, in a situation, in which I had to provide for the most comfortable and healthful warming of an apartment, appropriated to the instruction of youth, after trying various modes, in common use, I concluded it best to introduce heated air from a hot chamber; and in effecting this I was led to think, that the principle upon which it should be done is, at least, not well understood. In none of the works treating on heat and pneumatics, that have fallen under my notice, have I seen proper directions given. The principle, however, when explained, is so simple, that I feel diffident in attemping to make any communication upon it; but if it be correct (and as I find, that in your public buildings, where it is most needed,—such as the Exchange, Philadelphia Museum, U. S. Bank, most of your Churches, &c., this principle is not applied) I think it my duty to communicate my views.

It is manifest that when heat is introduced into a chamber, and the air is in consequence expanded, the wall making a resistance on all sides, there must be a certain force or impetus communicated to this heated air, which impels it through any opening made in the room. The place of exit is generally made at, or near, the top of the hot chamber, to communicate with the apartment to be warmed. The hot air being aided by the cold and heavier air on the outside of the chamber, pressing in by the feeding holes at the bottom, the force or momentum thus produced is expended in whatever direction the communication is made. If it be through a mere opening in the floor, as is generally done, the impetus, in connexion with the well known property of air (the colder and heavier pressing downward and displacing the warmer) carries it vertically to the ceiling of the apartment. And when there, what is it that will bring it down? It evidently cannot come down in any part of the apartment, where the air below is colder, and it is therefore only by a long continued process of introducing heated air that the apartment can be rendered comfortable, if at all, where the ceiling is very high. Now in my opinion, it should be so introduced, that while it is yet in a constrained passage, it should be directed horizontally along the floor, and this as nigh the floor as is safe to prevent ignition; and there should be no solid obstacle to interrupt its course. It will then only be displaced by the colder and heavier air pressing down and taking its place: then, whatever be the height of ceiling, we get at least the benefit of the warmed air in its transmission.—But some will say, this is nothing new; we have seen many places where the heated air is admitted in this way. Very true, but this was most probably by mere accident, where it happened to be the most convenient arrangement, and not upon any well understood principle; for if these views are correct why are they not acted upon in those buildings where an efficient mode is most needed? Others may doubt the correctness of my views, and without making experiments, condemn them; to such I would say, that I practically proved them, in the school room, already spoken of. This room is twenty-nine feet square, and fourteen feet high—the furnace was placed centrally in the cellar, and the heated air passed through a grate in the floor.—For two winters we burned nearly seven tons of coal, each winter,—for we had to keep up the fire at night, to render it even tolerably comfortable, yet the inmates always complained of cold feet. Last winter I placed a drum of sheet iron over the grate, which is thirteen inches diameter, and has three pipes jutting from its sides, five inches diameter, six inches long, and six inches from the floor:—now during the whole winter we burned but a little more than four tons of coal; the room was always more than merely comfortable, and the inmates declared that their feet were the warmest parts of their bodies: moreover, I found that the thermometer was only two degrees lower, when placed on the floor, nigh the wall, than it was within a few feet of the ceiling.

In addition I would say, that where the saving of fuel is at all important, and the purity of the air not so essential, we might have holes in the floor, in several extreme points of the apartment, and pipes leading from these to the bottom of the hot chamber, to supply air:—by this means we should withdraw the cold air from the floor of the apartment, it being always the lowest stratum, and supply its place by a stratum of warm air. By this mode, the atmosphere of the room would be at least as pure as when it is heated by radiation from a stove or fireplace. It may be objected, that by withdrawing the air we should invite more cold air through doors, windows, &c., but this is incorrect, for by whatever mode we warm an apartment, so long as the external air is colder, it will intrude by its greater density and weight.

Observations.—The experimental fact stated by Dr. Gries is valuable. If hot air from below enters an apartment to be heated, in horizontal currents, its heat will be sooner and more effectually imparted to the lower strata of the atmosphere of the room than if it ascend in vertical columns as is usually the practice. The complaint of cold feet, in parlours heated by warm air, is, if we are not mistaken, very common; and when the feet are cold, the whole system partakes more or less of the discomfort. This is perhaps the main reason why in rooms thus heated, persons who have been accustomed only to radiated heat complain sometimes of chilliness, when the thermometer on the mantel indicates a high temperature. We are not quite so sanguine, however, as to think that a simple change in the direction of the current, as practised by our correspondent, would in all cases produce a saving of three-sevenths of the fuel, while it adds to the comfort of the apartment. The experiment is worthy of acceptance. We would invite from our readers an account of good results on the heating of rooms by warm air. G.

Civil Engineering.

On the Tractive Power of the Horse. By Ellwood Morris, *Civil Engineer.*

There are perhaps but few subjects concerning which writers on practical mechanics differ more essentially than in stating the mean tractive force capable of being maintained by horses in common working hours from day to day.

Practical men seeking to apply horse power to various purposes, find upon resorting to books, such discrepancies as shake their confidence in the statements, even of the most respectable authorities, and induce them rather to assume for themselves an empirical standard.

At first view it would appear that a power of such antiquity, so commonly employed, and apparently so susceptible too of direct appreciation by experiment, would long since have received a determination, closely approximating to accuracy.

A nearer examination, however, developes difficulties growing out of the variety in muscular strength, to be noticed among horses even of the same weight, the difference in the capacity of prolonging exertion or keeping up a given pull for stated periods, which may be found amongst those of equal momentary strength, and the difficulty in experiments of registering the direct draught, owing to the traction being effected by *impulses*, "or strokes of the animals' shoulder against the collar," as aptly stated by an eminent writer.*

Another source of difference, much to be regretted, is that our authors do not always tell us, whether or not the tractive force given by them is the *effective draught* clear of friction.

The following Table 1, exhibiting the tractive force of the horse as stated by various authors,† shows considerable differences, and might be further extended, but that we have not the books at hand. In compiling this table, we observe that Mr. Smeaton's determination of a horse's power is stated at 250 hhds. of water *actually lifted* 10 feet high by pumps in one hour by one horse. We have therefore thought ourselves authorised in adding $\frac{1}{5}$ to this result for the friction of the pumps. The statements of the other authorities quoted, we take to be *total draught*, including friction.

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* John Mackneill, Esq. C. E. &c. See Trans. Instit. Brit. Civ. Eng.

† See Emerson's Mechanics; Allen's Mec.; Gregory's Math.; Wood on Rail Roads; and Tredgold on Rail Roads.

TABLE I.

1	2	3	4	5	6	7
Direct Draught.	Speed per hour.	Duration of the draught or hours wrought per day.	Pounds lifted one foot high per minute.	Effect in lbs. lifted one foot high per day of the stated number of working hours without deduction for friction.	Authorities.	Species of draught.
lbs.	Miles.	Hours.	lbs.	lbs.		
200	2½	8	44,000	21,120,000	Emerson.	Over a pulley.
125	2½	8	27,500	13,200,000	Desagulier.	Unknown.
150	2½	8	33,000	15,840,000	Boulton & Watt.	do.
121 7-10	2½	8	26,774	12,851,520	Smeaton.	Pumping water.
163	2½	8	35,860	17,212,800	Bevan.	In ploughing matches.
112	2	10	19,712	11,827,200	Wood.	On Rail Roads.
125	3	6	33,000	11,880,000	Tredgold.	do.
90¼	2½	8	19,855	9,530,400	Leslie.	Common horse.
156¼	2½	8	34,375	16,500,000	ditto.	Picked do.

Having for the last two years daily witnessed the application of horse power, to hoisting weights by simple machinery, we have thought it would not be without interest to practical men, to state the usual results of the labour of horses, under the circumstances referred to. It will at least be adding another direct fact to the information we now possess in regard to the tractive force of those animals.

The horse draught to which we allude is applied to gins (at the tunnel now constructing on the Chesapeake and Ohio Canal) in hoisting out by open buckets the water which accumulates in the shaft workings. The particular shaft (D*) where our experiments were made, is 188 feet deep, and usually has a hoist (clear of water surface in the sumph) of 178 feet. Two buckets are worked in this shaft, by ropes winding in reverse order around a drum, so that when one bucket is ascending, the other is descending, the direction of the horse's motion being reversed at the banking of each successive bucket, so as to produce on the whole, a reciprocating circular motion.

Dimensions about the Gin.

Hoist clear of the sumph, ...	178 feet.
Circumference of gin rope drum, ...	29.15 feet.
Do. of gin horse path, ...	89.85 "

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* See Journal Franklin Institute, vol. xxiii., page 24.

Ratio of motion of horse to that of the bucket, . . .	548 to 178
Circumference of the hemp rope, ...	5 inches.
Cubic contents of water in each bucket as it usually reaches top shaft, ...	$8\frac{4}{10}$ cub. ft.
Average friction of the gin, with the buckets empty in lbs. applied at the horse's yoke, ...	23½ lbs.
Average friction of the gin when loaded with $8\frac{4}{10}$ cubic feet of water, (525 lbs.) and moving at the usual pace, in pounds, applied with a steady pull to the horse's yoke, . .	26 lbs.
Ratio of the additional friction (2½ lbs.) to the applied weight, (525 lbs.)	$\frac{1}{210}$ of the weight.

The following Table II, exhibits the mean results of four different series of experiments gone into with the view of ascertaining the actual average draught of the gin horses working during one "miner's shift," or 8 hours out of 24.

The draught noted in the table below, is inclusive of the friction of the machinery, rigidity of the cordage, &c., which at a mean of twelve experiments, proved to be equal to 26 lbs. when the load was 525 lbs. as before stated.

All the experiments were made with two different animals (Nos. 1 and 2) of medium size and strength for ordinary horses.

TABLE II.

1	2	3	4	5	6	7	8
Experiments.	No. of the horse.	Total time of horse hitched up.	Time lost in every way per shift of 8 hours.	Time per shift of horse actually hoisting the weight.	Pace of the horse whilst actually lifting the weight in miles per hour.	Average draught while actually hoisting.	Dynamical effect produced by one horse in lbs. lifted one foot high per day of 8 working hours, without deduction for friction.
		Hours	h. m. s.	h. m. s.	Miles.	Pounds.	Pounds.
Average of the 1st series.	1	8	2 38 00	5 22 0	2.321	196½	12 922 384
Average of the 2nd series.	2	8	2 16 12	5 43 48	1.956	196½	11 628 399
Average of the 3rd series.	1	8	2 8 0	5 52 0	2.265	196½	13 768 566
Average of the 4th series.	2	8	2 0 0	6 0 0	2.076	196½	12 923 349

The actual amount of water lifted from the workings, by each horse in 8 hours work, and hoisted 178 feet, was found to be, on an average of all the experiments, near 62,475 lbs. or = 11,120,550 lbs. lifted *one foot* high per day.

In performing the above work from day to day, we have noticed that the horses employed barely kept in condition, thus signifying that they were working near to their maximum power.

We may divide horses generally into two classes, *picked* and *common.* And referring to tables I. and II., and selecting from the first those results which seem most conformable to practice, we shall find that the dynamical effect produced by

PICKED HORSES

$$\left.\begin{array}{lr}\text{According to Boulton \& Watt,} & = 15{,}840{,}000 \\ \text{Do. Bevan,} & = 17{,}212{,}800\end{array}\right\}\text{Pounds lifted one foot high per day.}$$

$$\begin{array}{r} \underline{\hphantom{0000000000}} \\ 2)33{,}052{,}800 \\ \underline{\hphantom{0000000000}} \\ \text{Average} = 16{,}526{,}400 \\ \underline{\hphantom{0000000000}} \end{array}$$

COMMON HORSES

$$\left.\begin{array}{lr}\text{According to Desagulier,} & = 13{,}200{,}000 \\ \text{Do. Smeaton,} & = 12{,}851{,}520 \\ \text{Do. gin horses C and O} & \left\{\begin{array}{r} = 12{,}922{,}384 \\ = 11{,}628{,}399 \\ = 13{,}786{,}566 \\ = 12{,}923{,}349 \end{array}\right. \end{array}\right\}\text{Pounds lifted one foot high per day.}$$

$$\begin{array}{r} \underline{\hphantom{0000000000}} \\ 6)77{,}312{,}218 \\ \underline{\hphantom{0000000000}} \\ \text{Average} = 12{,}885{,}369 \\ \underline{\hphantom{0000000000}} \end{array}$$

Whence finally we may perhaps take the mean day's work of horses when fully loaded.

Of { *Picked* horses at $16\frac{1}{2}$ *millions* of lbs. lifted one foot high per day.
{ *Common* do. at $12\frac{9}{10}$ do.

This average result for *common* horses is equal to a continued pull of near $135\frac{3}{4}$ lbs. at the rate of $2\frac{1}{4}$ miles per hour for* 8 hours out of 24.

The pace of $2\frac{1}{4}$ miles per hour, or more accurately 200 feet per minute, has been ascertained by the writer from numerous experiments upon horses hauling earth for embankments in single carts, as well as from some trials with teams of four, to be that at which those in common use on public works, generally proceed when working with full effect.

Oldtown, Md., July 15th, 1839.

Description of a Natural Bridge in Claiborne county, Tennessee.

By John C. Trautwine, *Civil Engineer.*

To the Editor of the Journal of the Franklin Institute.

Presuming that such subjects come within the scope of your Journal, I send you a description, and drawing, which I recently made of a Natural Bridge, hitherto undescribed, in Claiborne county, Tennessee.

It is generally supposed that Virginia possesses the only Natural Bridge in the country; viz: the one over Cedar Creek; but that is not the case; there are several others in East Tennessee, and Western Virginia, though all must yield in sublimity and grandeur to that over Cedar Creek. The one which forms the subject of this paper, spans the narrow valley of Gap Creek, a small stream which issues from the mouth of an extensive cave, at

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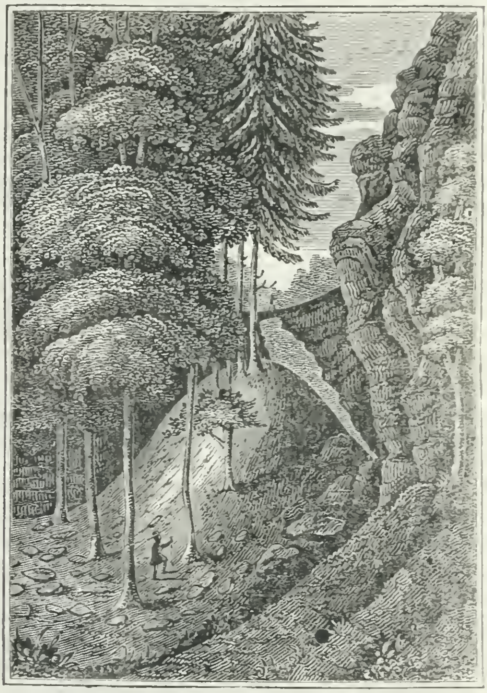
[*] The horses employed upon public works, averaging the working time of the whole year, are worked nearly 10 out of 24 hours, for which time, however, they would only be able to exert a mean force equal to a steady pull of about $108\frac{1}{2}$ lbs., and the pace and the dynamical result would both be found to remain nearly as above.

Cumberland Gap. It stands about five miles S. W. from the Gap, and is so little known, that but few persons even in its immediate vicinity, are aware of its existence; indeed it is only crossed at times, by the few persons engaged on the farm, and had never been visited through curiosity, until the party of which I formed one, determined to settle the disputed point of its existence.

It stands in a wood, about a mile north of the stage road from Jacksboro' to Cumberland Gap, and, as before remarked, about five miles S. W. of the latter point. The ravine across which it is thrown, is, just here, quite wild and romantic; being narrow, and bounded by masses of rock, either perpendicular, or over hanging, varying in height from fifty to one hundred feet; the average width of the valley does not, at the site of the bridge, much exceed thirty feet. The impressions it produces are, therefore, not so much those resulting from actual magnitude, as from the apparent size caused by proximity to it.



It is very evident to me that this bridge has, at some distant period, formed part of a cave, of which the overhanging rocks above and below it, have constituted the side walls; and the great fragments of sharp-angled masses, which in some places nearly block up the ravine, the roof. Immediately under the arch, these fragments are strewn to a depth of twenty feet; and a few yards below it stands a mound of very regular shape, perhaps forty feet in diameter, and as many in height, which I ascribe to the same source. This mound is shown in the drawing, where it conceals nearly two-thirds of the opening of the bridge; a view exhibiting the entire arch could not be had, as the mound extends entirely up to the bridge. This mound resembles in every particular, the Indian burial mounds, so common all over this section; and perhaps it would be safer to assume it to be, *in part*, the work of that people; especially as we can scarcely imagine that exposure to the weather, would crumble down the fragments of rock into soil, with such perfect regularity as the mound exhibits. Trees grow on it, which indicate that its formation took place some time ago; while large, sharp, and freshly broken fragments which cover its base, indicate that the process is not yet complete.

A strong evidence of the former existence of a cave, is that the creek here flows not *in*, but *beneath* the bed of the valley, having I suppose been forced to seek its subterranean channel, by the obstructions offered to its original course, by the falling-in of the roof of the cave; it issues from the ground some few rods below the bridge. Like most of the streams in this vicinity, however, it sinks into the ground, and reissues in many places.

The height of the roadway above the valley, would, if the fallen blocks were cleared away, be about seventy feet; the span at the bottom is about twenty-five feet, but at top, not more than twelve, forming a kind of rude parabola. The width of the roadway is fifteen feet; and the thickness of the arch in the centre, not more than two and a half feet. From its being much cracked, it has every appearance of soon falling in; there is, however, a farm road over it, the wagons of the farm cross it in safety, and it may, perhaps, endure for centuries to come.

The rock is a grey, stratified limestone, which, just at the bridge, approaches to a slaty structure; the strata lie parallel to the nearly horizontal roadway; and indeed the thickness of the arch at top, is composed of one flat layer, extending across it. The adjacent rock is more compact.

I was much struck with the appearance of this bridge, more especially as I had been half inclined to doubt its existence, and it was, therefore, rather an unexpected treat. I consider it certainly the wildest and most romantic little *morceau* of scenery I have ever seen. It cannot, of course, compare with the stately grandeur of the Cedar Creek Bridge; but still in consequence of the almost immediate contact into which you are brought with it, and the idea which forces itself upon you, that you are shut up with it, from the rest of the world, by the overhanging rocks of the ravine, render it very interesting, and you gradually contract quite an affection for it. I made a careful drawing of it on the spot.

Before concluding, I must remark that the vicinity of Cumberland Gap is one of the most interesting places I have ever visited. The surrounding mountain scenery is magnificent; and the whole of East Tennessee, East Kentucky and Western Virginia abound in caves, natural tunnels, and bridges, to such an extent that the traveller can scarcely stop at a house, whose inmates cannot in a few minutes, conduct him to either one or the other. The geological features of the country are of unusual interest; coal, lime, sandstone, gypsum, iron, lead, salt, &c. &c., abound throughout; and mineral waters of various descriptions are to be met with in every part.

I found in the immediate vicinity of the Gap, a variety of iron, which is new to me, and probably to mineralogists, as I have never seen descriptions of any resembling it. It is a compact red oxide, of a stratified structure, and consisting almost entirely of vegetable remains, exhibiting distinct impressions of leaves and nuts. It has a granular appearance throughout, produced by an immense number of flattened globules, evidently vegetable, and probably seed, which constitute the greater portion of the mass. This iron formation is very abundant here, it is associated with red shale, and is worked as an ore; it yields about fifty to sixty per cent. of pure metal. The workmen mistook the globules for the common granular ore.

I forward to you a few specimens, for the cabinet of the Institute; together with a specimen of native iron, from Cocke county, Tenn.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN AUGUST, 1838,

With Remarks and Exemplifications by the Editor.

1. For *Manufacturing Leaden or other Metallic Pipes;* R. M. Seydle and Lewis Ward, Northumberland county, Penn., August 1.

The lead or other pipe to be manufactured is to be cast upon one end of a polished iron mandrel, and is then to be passed between rollers which have grooves turned on them in the manner of those used for rolling round bar iron, the grooves successively diminishing in size. The claim is to this process or method of forming metallic pipes.

2. For *Cards for Carding Cotton, Wool, &c.;* George Faber, Canton, Stark county, Ohio, August 1.

The card intended is the common hand card, and the patent is obtained for using a foundation of wood instead of leather for containing the teeth. A veneer is to be cut of a suitable thickness, and reduced to the proper length and width, and this, after being steeped in water, is to be put into the card machine where it is to be pricked and stuck with teeth, in the same manner as leather is stuck. There is not any claim made to the machine, but only to the use of the foundation of wood.

3. For an improvement in the mode of *Converting a Reciprocating into a Rotary Motion;* Charles A. Watson, Green River, Kentucky, August 1.

There may be cases in which a device like that which is the subject of the present patent may be of use, as the changing of a reciprocating into a rotary motion, is a thing often required in machinery of different kinds. The patentee states that he has "invented a new and improved mode of arranging a double rack and ratchet wheel, in virtue of which arrangement the racks engage with and disengage from the ratchet wheel in a more perfect and advantageous manner than by any of the plans heretofore adopted;" all of which may be correct, but whilst the general intention is to apply such an apparatus as a substitute for the crank in steam engines, it must prove an utter failure; in several of the plans which have been tried the difficulty has not been in the manner of arranging the parts, the defect is more deeply seated, being inherent. The crank, instead of being liable to the objections which have been urged against it, is, we believe, perfect in its action, and, if so, all substitutes must be bad in principle.

The patentee confines his claim to the peculiarities of his mode of arrangement, which we shall not attempt to particularize.

4. For an improvement in *Fire Arms,* applicable alike to smal

arms and Cannon; Hezekiah L. Thistle, New Orleans, Louisiana, August 1.

The chamber part of the fire arms, whether of the musket or cannon kind, is attached to the breech by a joint pin, so that it may be turned up to receive its charge. The chamber part is provided with a rim which fits into a corresponding recess turned out in the rear end of the bore of the barrel, which device the patentee denominates a flute joint. The chamber part is made capable of receding, and is born up by a wedge after it has received its load. When this device is applied to cannon, they are to be made of wrought iron. In muskets a sword is to be substituted for the bayonet, there being proper devices on the handle for shipping and unshipping it. The claims made are to "the tail piece, the flute jointed chamber, connected by a joint; the wedge, oval rollers, bed, and springs, in combination therewith; the manner of shipping the sword; the flute jointed chamber and its guide screw or bolts, the bed, wedge, racks, pinion, cam and cranks, in combination applied to cannon and field pieces, operating as described."

The claim, it will be seen, is to a number of minute particulars in the mode of constructing the apparatus, not admitting of verbal description. Some of the things named are not new in their individual capacity, and if sustained, can only be so in their peculiar combination.

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5. For *Manufacturing Leather*; Adam Hickman & Edwin L. Davenport, Abingdon, Washington county, Virginia, August 1.

(See Specification.)

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6. For an improved *Adhesive Compound for Binding Books;* David Felt, city of New York, August 1.

(See Specification.)

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7. For improvements in the *Brewing of Beer, &c.;* Thomas Behan, Norwich, Chenango county, N. York, August 1.

(See Specification.)

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8. For an improvement in the manufacture of *Ploughs of Cast Iron;* Cyrus Alger, Boston, Massachusetts, August 3.

(See Specification.)

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9. For an improvement in *Generating Steam;* Phineas Bennet, City of New York, August 3.

The claim under this patent is to "the employment and construction of an air tight furnace into which air is to be blown under considerable pressure, combining with said furnace the cap valve, as described, with its appendages, or any other similar apparatus constructed so as to operate substantially in the manner set forth; I do not claim the air tight furnace with its blast, independently of the above named combination. I likewise claim in combination with such a furnace and cap valve, or any other analogous apparatus, an air tight reservoir for fuel, constructed in the manner, and for the purpose of supplying the furnace with fuel without interfering with the pressure of the blast by which the combustion is kept up.

The engine which is above referred to was intended especially for ocean service, and a large amount of money has been expended in the essays made with it, but, as is commonly the case in such undertakings, many difficulties have been encountered; the plan, however, has not been abandoned, and it is still hoped that the engine may be made a useful one. What is called the cap valve, was esteemed a principal feature in the improvement, most of the other devices having been used in different combinations. The cap valve is intended to force all the gaseous products of combustion to pass through the water in the boiler, which it effects in the following manner. These products of combustion ascend through a flue which terminates a short distance above the surface of the water in the boiler; the cap valve is an inverted vessel, the mouth of which dips into the water surrounding the flue, so as to force the heated air to pass down through said water; the cap valve is made adjustable so as to dip into the water to such distance as may be found most beneficial.

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10. For *Protecting Notes, Checks, &c. from alteration;* Ebenezer Watson, Albany, New York, August 3.

(See Specification.)

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11. For an improvement in the construction of the common *Hand Bellows;* John Grennell, Springfield, county of Hampden, Massachusetts, August 3.

The hand bellows, which is the subject of this patent, resemble the ordinary smith's forge bellows; that is, to say, there are three boards, the middle one being fixed, and the upper and lower boards being moveable; to the two lower boards there are handles, and they have both valves or clacks, opening upwards. Between the two upper boards there is a spring which draws them together, and thus supplies the place of the weight in the forge bellows. The wind escapes from the upper compartment, through the nozzle. The bellows may be used with either side upwards. The claim is to the use of the spring as set forth.

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12. For an improvement in the *Peck-hammer, for pecking Mill and other Stones;* Bela Gardiner, Ashfield, Franklin county, Massachusetts, August 3.

Peck-hammers have been made by taking two pieces of iron, each in the form of a half hammer, and securing a plate of steel between them, by means of screws or wedges; the present patent is taken for an improvement in this kind of hammer. The steel plate is to be upset at its upper end so as to form a ledge on each side. The cheeks of the hammer have several grooves along their inner sides, from front to back, to admit these ledges, and the steel plate, as it wears down, may be lowered by the aid of these grooves, and held firmly when in use. The claim is to "the addition of the shoulders or projections on the upper part of the chisel plate, fitting into the channels in the faces of the cheeks in manner, and for the purpose herein described," &c.

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13. For an improvement in the *Horse Power;* Orrin Straight, Lycoming county, Pennsylvania, August 3.

This horse power is of the kind that has an inclined movable endless floor, consisting of slats of wood united together by jointed straps at their edges. The improvement claimed is to "the manner in which the projections of the pieces which receive the slats are made to bear upon the edges of the straps;" the object being to afford strength to the floor, and check its tendency to swag; a number of patents have been obtained for the same purpose; but the plan before us appears likely to prove superior to most of its predecessors.

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14. For a portable *Cider Mill and Press;* Frederick Fredley, Sugar Valley, Lycoming county, Pennsylvania, August 3.

This mill and press consists of a box, like a fire engine box, upon wheels. Two vertical cylinders serve to grind or mash the apples, a horse being geared to a sweep upon the axis of one of them. The pommage falls into an interior box, lying horizontally, and within which a follower is to be forced along to press out the cider. The claim is to "the mode of operating the press by means of the double rack, combined with the slide for throwing it in and out of gear; and also the combination of the machine for mashing and reducing the apples, in the manner described; that is, by attaching the pinion which works the rack of the press on to the axis of one of the rollers of the reducing or mashing machine."

We can scarcely conceive of the passing of a patent, under the existing law, with less to merit the character of substantial novelty than that before us; but as in nice weighing the dust may turn the balance, so also in an application for a patent, the turning point may be minute in the extreme; such we think must have been the case in the present instance, and the patent was therefore issued on the point of doubt.

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15. For an improved mode of *Generating Steam;* Horatio Hubbell, City of Philadelphia, August 6.

(See Specification.)

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16. For an improved mode of *Preserving Timber;* Samuel Ringold, of Florida, and Edward Earle, Savannah, Georgia, August 6.

(See Specification.)

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17. For an improvement in the mode of *Preparing Corn Husks for the Manufacture of Paper;* Homer Holland, Westfield, Hampden county, Massachusetts, August 13.

(See Specification.)

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18. For *Constructing Timber Rail Roads by Power Machinery;* James Stimpson, City of Baltimore, August 13.

The drawings appended to this patent are necessarily complex, and the claims refer to the different devices represented in them, and would not, alone, convey any correct idea of the particular manner in which the respective parts of the machinery are arranged. The general object of the invention is the same with that of Mr. Smith Cram, patented on the 14th of June 1838, namely, to drive piles, and to cut off, and grade them, for timber rail roads, passing over low grounds; the apparatus employed being sustained upon said piles, and progressively advancing as the work goes on. The two applications were considered as interfering by the office, and the case was referred to a special board of examiners, under whose decision the two patents were issued in the form which they now bear; we learn, however, that it is the intention of Mr. Stimpson to remodel his apparatus, and to apply for a new patent, and should this be done, we will place the matter in its amended form before our readers, as fully as the nature of the case will allow.

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19. For a machine for *Cutting, Dressing, and Beading Marble and other Stone, &c.;* John D. Buzzell, Cape Elizabeth, Cumberland county, Maine, August 13.

The patentee says that he has invented a "new application of the use of malleable iron sockets, and malleable steel cutters, to be used in revolving cylinders for the purpose of dressing, grooving, and beading marble, and other stone; and a new application of lateral motion to the revolving cylinder for the purpose of grinding and making even the points or edges of the tools; and in the cast iron cylinders for dressing marble and other stone."

A patent was obtained by Mr. Buzzell for a machine for a similar purpose, on the 15th of May 1837, upon which the present purports to be an improvement; the description given refers to more than twenty figures in the drawings, which are necessary to the understanding of the thing, where much relates to peculiarities in shape, and reference is made throughout to the former patent. We are informed, moreover, that this, in common with several other patented machines for a like purpose, has hitherto disappointed the hopes of the inventor, and when the nature and difficulty of the business to be performed are duly considered, success might surprise us, but disappointment cannot. The claims, as given, would not afford any insight into the particular structure of the parts claimed.

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20. For an improvement in the *Brick Press;* Nathan Sawyer and Thos. W. Smith, Washington, D. C., August 13.

This patent is taken for an improved manner of filling the moulds, and of removing the brick, in machines intended for pressing brick from dry clay, such as that for which letters patent were obtained by Nathan Sawyer, on the 8th of April 1835, but which may also be applied to other machines.

The pulverized clay is to be put into a hopper, and under this hopper there is a sliding feeder having an opening through it to contain clay enough to fill the mould, and this being made to traverse backward and forward, receives the clay from the hopper, and deposits it in the mould, in doing which it pushes off the brick last moulded.

The claim is to "the whole arrangement of the feeder taking its supply from the hopper, supplying the mould, and removing the pressed brick, as set forth; also the application of the box within the hopper, which is attached to the hopper by cloth or leather passed loosely over the top of the box, to allow said box to pass freely up and down over the surface of the feeder, as described."

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21. For an improved method of *Attaching Awls to their Hafts;* Dexter Pierce, Montague, Franklin county, Massachusetts, August 13.

The claim made is to the "enclosing and attaching, between two cylindric pieces of metals, awls of various kinds; of securing or staying the same to their hafts, and of elevating or depressing the points of sewing awls, as set forth in the specification and drawings."

There have been several patents for various modes of adapting a number of awls to one common handle, and that before us, will, most probably, not be the last; we cannot take the time and space necessary to point out the differences in such an affair, where we see little more than a variation in the means employed, without any substantial improvement.

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22. For a *Gravel Pump;* Laura Rice, Administratrix of J. J. Rice, and Ebenezer Rice, Salina, New York, August 15.

"This pump, or machine, is inserted in a well, or shaft, which should be properly tubed with cast or sheet iron, or other proper material, with space to permit it to pass readily, and having a rope, or cords, connected with the end of the piston, is worked in the manner of a pump until sufficiently charged with the substance to be removed, when it is raised by a windlass, or other power. It is particularly adapted to the excavations of shafts for brine, and was discovered whilst excavating wells for that purpose, as no instrument was known which would readily raise the gravel from the beds without great delay and difficulty, and at the same time leave the sides of the well bare and pervious to the transmission of brine, the ordinary process of drilling merely crowding the staves from the shaft, and rendering the sides of the well compact, hard, and nearly excluding the passage of small streams of brine into the well."

The form of the exterior of the machine is that of two cylinders differing in size, the smaller standing above the larger; the lower cylinder is to be about 11 or 12 inches in diameter, and twenty-one in height; the upper one may be eight inches and a half in diameter, and fifteen in height; they are connected by an offset, are hollow, and made of cast iron; the upper cylinder forms a pump chamber in which a piston is to work. The lower cylinder constitutes a receiver to retain the sand and gravel drawn into it by the action of the pump. In the bottom of the lower cylinder there is a round opening of six inches in diameter, and the upper and inner edge of this opening is surrounded by pieces of whalebone, or other elastic material, which rise from it so as to form a cone somewhat like that of the pointed converging wires in some rat traps; these may be six or seven inches long. They allow of the passage of stones and gravel into the chamber, and prevent their return. This elastic material is surrounded by a sleeve of cloth, which admits sand to pass up and around it.

The claim is to "the manner of connecting and combining the respective parts of the above described machine, for the purpose of excavating wells and shafts, and the removal of sand and gravel therefrom; that is to say, the combination of the exhausting apparatus with the cylinder, the conical bars of whalebone or other material, and the canvas surrounding the same, constructed and operating in the manner set forth."

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23. For an improvement in the *Power Loom;* William B. Bender and Nathaniel C. Horn, Wolfsborough, Stafford county, New Hampshire, August 15.

"The improvement consists in a new method of raising the harness of the loom," which are said to be "more simple, and easier of being raised to suit different figures or fabrics to be woven, than those heretofore known and used." What is called a "working frame," is elevated above the harness by two standards; this is operated upon by motion communicated from the shaft, but the arrangement of its parts cannot be readily described in words. The claim is to "the working frame with the spring bed, in combination with the horizontal levers and vertical arms; and in combination therewith the cylinder and arms for moving the arms and levers, and causing an alternating motion of the levers for raising the harness, as described."

24. For a *Machine for Crimping Leather for Boots;* Nathaniel Woodbury, Calais, Washington county, Maine, August 16.

The leather is to be forced on to a former, made in a manner so similar to that employed in several other machines, as to deprive this of all claim to novelty in its general construction, and the patent, therefore, is confined to the manner of constructing a bevel block, and the arrangement of two levers, which will probably do the work as well as it can be done in the various ways previously patented.

25. For a *Mill for grinding or bruising flaxseed and other substances;* George L. Stearns, Boston, Massachusetts, August 17.

The seeds are to be bruised, or ground, by two or more pairs of metallic rollers, said pairs of rollers being placed immediately over each other, so that the seed which passes between the upper, shall fall upon the lower pair. The rollers of each pair are to be unequal in size, that they may produce a rubbing effect on the seed. The claim is to "the mode of grinding flaxseed, or other substances that may be reduced therein, by cylinders or rollers, constructed, placed, and operated as above described."

Rollers have been used for bruising and grinding seeds, and they have been made to run with different velocities, but possibly not with two or more pairs in succession, as by the present patentee; in this, therefore, consists the only novelty, if novelty there be.

26. For an improvement in *Saw Mills;* Cornelius Van Alstine, Manlius Centre, Onondaga county, New York, August 18.

In this mill, the side timbers of the saw frame are to extend considerably below the lower cross-piece, so that a crank shaft, furnished with two cranks, may pass through them, the side pieces serving the purpose of pitmen. The crank is to have but a small throw out, say an inch, or upwards. The timbers of the frame are also to extend up above the saw, and are to have jointed bars running horizontally behind them, these bars being connected by joint pins to the said frame, at one end, and to the framing of the mill at the other. The patentee says that this "will enable sawing to be performed with a short crank, by the help of the guide arms to the upper end of the saw gate, and the saw will clear itself by repeatedly drawing down the sawdust, even with an inch crank only." The claim is to "the application of the crank to the bottom of the side pieces of the saw gate, in combination with the guide arms, the whole constructed and operating substantially as herein described." The averment made may be very true, but we confess ourselves unable to discover from what source any advantage is derived from the proposed arrangement.

27. For a mode of *Heating Buildings, and Evaporating Fluids;* Angier M. Perkins, a citizen of the United States, residing in London, August 20th.

The specification of this patent is published in vol. x., p. 45, of this Journal, a patent having been obtained in England in the year 1831, but the grant was accidentally delayed in the United States, and it was at length issued under a special act of Congress, passed for that purpose. The plan has been extensively carried into effect in Great Britain, the British Museum, and a number of other public, as well as private, buildings, having been heated upon the principle patented. It has also been essayed in New

York, and the published reports speak highly in its favour. Mr. A. M. Perkins is the son of the well known Jacob Perkins, Engineer.

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28. For an improved mode of constructing Metal *Bench Vices;* Thomas and James Keane, Haverstraw, Rockland county, New York, August 20.

This is a very ingenious, simple, and, we believe, perfectly novel mode of constructing bench vices. The instrument can be made as cheap as the ordinary vice, and, we suppose, even cheaper. The screw is a short one, and there is no screw box passing through the vice below the jaws, this part being made of a solid bar of iron, and the end of the screw pressing against the front of the fore jaw, in the part where the ordinary screw enters it.

A quadrangular frame of metal is made, of an oblong form, the space between the two sides embracing the legs of the vice below the jaws, and through one end of this frame passes the short screw by which the jaws are to be closed. Behind the vice, in the situation usually occupied by the screw box, there is a piece of iron formed into steps, so as to constitute a ratchet upon which the back end of the frame may catch. The jaws are forced apart by a spring in the usual way, and when any article is placed between them, the hand is pressed against the fore jaw, and the back end of the frame catches upon one of the steps of the ratchet, when by a turn or two of the screw the article will be firmly held. The claim is to the manner of constructing vices, in accordance with the foregoing description.

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29. For a *Smut Machine for cleaning Grain;* John Parker, Sunbury, Delaware County, Ohio, August 23.

In this machine the grain is conducted from a hopper into a vertical, hollow cylinder, toothed on the inside, and within which are revolving arms, or wings, moving rapidly, so as to beat the grain backward and forward with great force. The claim made is to "the peculiar form of the curved punched wings, fastened to the shaft, revolving within the centre of the cylinder, that is to say, in having the side of each wing which is fastened to the shaft made straight, and then curved backward from the shaft to its outer extremity, and braced by arms radiating from the shaft, to the ends of which the curved wings are fastened, as herein described."

Those who are acquainted with the construction of the different smut machines now in use, will perceive that there is but little that is new in that before us; when examined in the patent office, it was, of course, supposed to possess sufficient novelty to entitle it to a patent; we should not, however, impeach the judgment of a juror who should pronounce it substantially the same with some of its predecessors.

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30. For a machine for *Moulding Bricks;* John Bolton, Saratoga Springs, New York, August 23.

The moulds into which the bricks are to be pressed, are placed in sets, one behind the other, upon a rectangular frame, which is to be made to pass horizontally, by means of racks and pinions, under the hopper containing the prepared clay; in the drawing, each set is a box of five moulds, and there are five such upon the frame. The back part of the hopper is, in part, formed of what is called a forcer, which may be brought down upon the tempered clay, like a box lid, so as to force it through the grating which constitutes the bottom of the hopper, into the moulds below. The forcer is made to descend, or rise, by means of a segment rack and pinions. The horizontal frame is to be moved on until all the moulds are filled. In case of obstruction from stones, the frame, under the hopper, may be lowered by turning a shaft carrying an eccentric roller, or two eccentric wheels, which support the frame. The claim is to the forcer, and the eccentric roller, or wheels, combined and operating as above described.

31. For a *Smut machine for cleaning Rice, Wheat, and other Grain;* Daniel H. Southwork, Little Falls, Herkimer county, New York, August 23.

In its general form and mode of operation, this machine resembles several others. It has an outside shell composed of staves of cast iron, within which revolves a conical apparatus of beaters and rubbers, which are to operate upon the grain. The claims are confined to the particular construction and arrangement of the parts constituting the rubbing and beating surfaces. The terms of the claim do not afford any correct idea of the form of these parts, nor can they be readily explained without the drawing.

32. For a machine for *Thrashing and Cleaning Clover Seed;* William Rowe, Frederick, Frederick county, Maryland, August 25.

We are informed that " the distinguishing feature of this machine consists in a very simple combination and arrangement of an apparatus for thrashing out the seed from the hulls. A circular revolving screen into which the seed and chaff are delivered for separating the one from the other, a revolving fan for cleaning the seed, a vibrating screen placed below the revolving screen for more perfectly cleaning the seed, and an endless movable apron, or conveyor, for conveying the seed to any place desired." So far as this general description goes, the respective parts do not present any thing of novelty, the whole of them having been before used for a similar purpose; it is only to the peculiar manner of connecting and operating these parts, therefore, that a claim can be made, and this it is not necessary to give, as it refers to the description for its illustration.

33. For improved *Machinery for Raising Heavy Bodies;* George Kilburn, Walpole, New Hampshire, August 23.

This is, apparently, a well arranged machine; the particular intention of it is not mentioned, but it is to answer purposes similar to those effected by jack screws, and it is stated that it may be used as a press by placing a follower on its upper end. The power is applied through the intervention of two toggle joints, or progressive levers, the lower ends of which rest on the base, or foundation of the machine, and their upper ends are sustained by a frame which carries palls that take into ratchet teeth on a vertical shaft which slides up in the middle of the apparatus, the distance gained being kept by palls taking into ratchets at the lower end of the vertical shaft. The toggle joints are made to vibrate by means of a shaft crossing the machine horizontally, and carrying pitmen, or connecting rods, to the toggle joints. On one end of this horizontal shaft is hung a pendulous, weighted rod, which is to be swung backward and forward. The claims made are to the special arrangements above indicated, and to some others which we have not noticed.

34. For apparatus for *Preventing Cattle from getting on Rail Roads;* David Green, Greenfield, Saratoga county, N. York, August 25.

This is a device which will never be used, as every competent engineer would at once pronounce its death warrant; a gate is to cross a rail-road track, and the cars, or locomotive, is to bear upon certain lever rails, placed along the ordinary track rails; by means of which, said gate is to be opened; there is an array of levers, pulleys, and weights, which are to be called into action, and woe betide the gate should any one of these be out of order. The idea of keeping cattle from a rail road, by a gate crossing it, has the merit of singularity, as but few men would conceive it to be of any use in long continued lines of unenclosed woods, waste grounds, and a hundred crossing roads and paths, with which our roads are plentifully furnished.

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35. For a *Cooking Stove;* Simeon Heywood and L. P. Fisher, Claremont, Sullivan county, New Hampshire, August 29.

"The invention claimed, and desired to be secured by letters patent, consists in the particular manner in which the flues are arranged and combined, at the back of the oven;" and in the almost infinite variety of stoves which are made the subject of patents, a large proportion of them present nothing of novelty beyond some slight alteration in the manner of arranging the flues, from which their projectors, it is true, anticipate very important results, but which are rarely known after the lapse of two or three years.

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36. For an improvement in the *Machine for boring Rocks;* George C. Doherty, Cumberland county, Kentucky, August 29.

This is a device for giving to the shaft which carries the drill, or boring tool, the necessary motion by the application of animal power. The claim is to the manner of connecting the shaft of the auger with a lever, treadle, and pitman, so as to produce the desired effect; there is not any thing in the particular arrangement of these parts which appears likely to accomplish the proposed end any better than that of many others which might claim an equal share of originality.

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37. For an *Endless Chain Horse Power;* Amos Parker, Windham, Cumberland county, Maine, August 30.

The endless chain of slats is to be supported upon friction wheels, which run upon a wedge-formed railway, the ends of which railway are rounded to allow of the passing of the friction wheels round them. There is some slight peculiarity in this arrangement, but nothing to render it superior to others, or to merit any detailed description.

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38. For an improvement in the *Platform Balance, for Weighing;* John D. Dale, Lansingburgh, New York, August 30.

The patentee states that the principal improvement in relation to platform scales, or balances, "consists in having two beams to one scale, differently graduated; as one by a division by tens, fifties, hundreds, or the like; and the other to units, or the fractional parts of a unit, with a sliding weight or poise to each; and either connecting the beams with each other on the principle of a double lever, or as a beam having one fulcrum, with two bars for its longest arm, running parallel to each other, and united by a cross-bar at each end," &c. &c. After representing the respective modifications referred to, the claims are made to "the combination of two steel-yards, as described, the manner of constructing the lower lever and friction rollers; the sliding weights in manner, and for the purposes described; the making the sliding weight with a nonies, dividing it into fractional parts; the arrangement of the levers by which the platform is connected with the scale beam." There is, undoubtedly, novelty sufficient in the particular arrangements referred to, to justify the grant of a patent, but we really cannot find any thing in this novel arrangement of certain parts which renders the apparatus more accurate, or more convenient, than some others before in use.

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39. For a machine for *Sawing Clapboards;* Crawford Tyler, Millford, Hillsborough county, Maine, August 30.

The clapboards are to be cut by a circular saw from quartered timber, rived into bolts of suitable length. The round side of the quartered timber is sustained upon the carriage by means of two hollowed, or curved head blocks, in such a position as that when not held by the dogs it will slide down upon the head blocks, against two stops, which determine the thickness of the thick edge of the clapboard; it is then seized by dogs upon the carriage, and forced up by hand against the revolving circular saw. The claim is to the manner in which the dogs are constructed and operated, in combination with the stanchions, or curved head blocks, stops," &c. This machine is simple, ingenious, and, we doubt not, fully answers the purpose intended.

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40. For a *Marine Railway:* Robert W. Tindle, Administrator of Israel Riggin, Baltimore, Maryland, August 30.

This railway is intended to receive two vessels at once, so that both may be under repair at the same time, whilst one may be launched without disturbing the other. From the description and representation given, the apparatus appears to be adapted to small vessels only; the matter, however, is not made very clear, and we are not disposed to devote much time to the study of it. To give the claim would be useless.

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41. For a *Vertical Tooth Extractor;* David H. Dickey, Boston, Massachusetts, August 30.

We have not yet found a vertical tooth extractor which we have thought worth using, excepting it be a good pair of forceps, a strong wrist, a stout grip, and a well managed thumb for a bearing. We have seen many vertical tooth extractors, some made abroad, and a number patented here, from the time of Bruff's, upwards of forty years ago, to the present day; we have owned some, have drawn many teeth, but never with a vertical extractor, because we have not liked them, and the new acquaintance now introduced to us has not insinuated itself into our good graces, as it appears to possess the common faults of the family, faults which we think are inherent, and, therefore, have little for hope to act upon.

In the instrument before us, the tooth is to be embraced between two claws, working on a joint; these claws are kept open by means of two springs, acting between them, and are made to take hold of the tooth by means of a pointed shaft, or circular wedge, the end of which is forced, by means of a screw, in between the heads of the claws, above the joint pin. A plate of metal, perforated to admit the claws and the tooth to pass through it, is to lie upon the teeth contiguous to that to be drawn, and a lever connected with this plate by a hinge joint, is depressed in order to raise the tooth. Now it so happens, and must happen until the laws of nature are changed, that action and reaction are always equal, and in contrary directions, and by the operation of this law the contiguous teeth will be subjected to as much force inward as will be exerted upon the extracted tooth to draw it out; and it will so happen that the whole of this force will be exerted upon two teeth only; this is the objection to such instruments in common, and is not the only one, although we deem it sufficient.

The claims are, "1st. The lever (qr. shaft) working in a female screw, with one end pointed, and forming a revolving wedge for opening the upper parts of the forceps, thereby contracting the lower, or that part which is made to adhere to the tooth, in combination with the other parts of the instrument, as described. 2nd. The springs which act on the inside of the forceps for opening the lower part when the revolving wedge is removed, in combination with the lever, as set forth. 3rd. The peculiar arrangement of the different parts of the instrument, substantially as described and set forth."

42. For a machine for *Turning Tree-Nails, Bannisters, Rake Handles, and other cylindrical articles:* Joseph E. Andrews, Boston, Massachusetts, August 30.

The tree-nail, or other article, is to be formed by placing it in a common collar and mandrel lathe, in the ordinary manner, and it is to be turned by means of a sliding head, the upper end of which is a hollow, or tubular box, containing cutters for roughing and smoothing the article to be turned, which article passes through the tubular box, the sliding head being forced by hand from the mandrel to the front centre. The claim is to "a cylinder or other properly shaped body, with screws and cutters constructed and operating as described, for the purpose herein above mentioned."

The only difference between this instrument and such as we have seen in use, and used in days of yore, is that the cutting head or box, with its cutters, was, in the latter, held in the hands, and passed along the piece to be rendered cylindrical, instead of being on a sliding head, passing along the shears of the lathe. Such a tool, we apprehend, has had many hundred inventors, and been used by many thousands of workmen.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent for an Elastic Adhesive Compound for Binding Books; granted to DAVID FELT, *City of New York, August 1st,* 1838.

The nature of my invention consists of an elastic, adhesive compound for attaching the leaves of books together, which entirely obviates the necessity of sewing. The following is the method of preparing said elastic, adhesive compound.

Take eight parts of isinglass, two parts of gum arabic, and after soaking them in a little rain water until they become soft, add four parts of pure honey, then dissolve the whole with alcohol over a slow fire.

Mode of application. The section or folds of the book are first made in the usual manner of one sheet, and carefully pressed and knocked up on the back, and cut on the front. The back is then put into a curved mould to give it a proper form. It is then put between two cutting or press boards, and placed in a press and screwed up; after which the back is made rough, and the elastic adhesive compound applied with a stiff brush, and then left to dry; when dry, or nearly so, another coat is put on, so as to form a sufficient body. Some cotton or other flexible cloth is then prepared, with two coats of the compound; a strip of this cloth is then put quite over the back, extending down on each side about two inches, and after rubbing it well on the back to make it adhere, and leaving it a short time to dry, it will be ready for binding in the usual way.

When books are printed and folded in sections of more than one sheet (qr. two leaves) to a fold, the back is cut off and the process continued as heretofore described.

This compound may also be used as a substitute for glue when books are sewed and stitched in the usual way.

The discovery claimed, and desired to be secured by letters patent, is the elastic adhesive compound above described, for binding books.

DAVID FELT.

Remarks by the Editor.—The foregoing compound is intended to be used as a substitute for the solution of gum-elastic claimed in the patent of Mr. Hancock, vol. xxii., p. 86, and previously essayed by Mr. Breed (vol. xxiii, p. 67.) The objection to this substitute is that it will be equally liable with common glue to be effected by dampness, an objection to which the gum-elastic will not be liable. We doubt, however, the equality of the gum-elastic-binding to the common process; we have seen some of the books bound under the direction of Mr. Breed, and have found that a single leaf may be easily detached; this, it is true, may arise from the imperfectness of a first essay, but we should be unwilling to subject valuable books to the trial. As respects the recipe given by Mr. Felt, and claimed as new, we much doubt the validity of this claim, as a compound of glue, gum arabic, and sugar, is not new. The alcohol is not a solvent of the fish glue and gum, and is of no other use in the compound than to prevent its putrifaction. Whiskey, or other ardent spirits, will answer the intention equally well.

Specification of a Patent for an improvement in the mode of dressing and finishing leather; granted to ADAM HICKMAN *and* EDWIN L. DAVENPORT, *Abingdon, Washington County, Virginia, August 1st,* 1838.

The practice of finishing and dressing upper leather as at present used, is, when it is drawn from the vat, whilst wet, it is shaved, then oiled on the grain side, the grain then turned and the flesh set down with a *slecker*, then stuffed out. This is a process known to curriers as that of covering the flesh side with a composition of oil and tallow. It is then hung up to dry, and when fully dry, taken down, beaten on a pin block, then boarded up, and the flesh set down with a stone instrument. These last operations are necessary to fit the leather for whitening, or dry shaving, to remove the coating of oil and tallow so that the leather may be prepared to receive the blacking.

Our mode is this, when the leather is taken from the vat, wet, shaved, oiled on the grain side, and the flesh set down in the usual manner, it is then simply oiled on the flesh side, dried, pin blocked, boarded, and trimmed, and is then ready for blacking.

By this mode there is a considerable saving of labour; it excludes boarding up once, and leaves the whole tedious routine and very laborious operation of dry shaving, or, as it is commonly called, whitening, well known to all curriers as making a large amount of the labour sustained in fitting up leather for the market. The shoulder and flank are kept much thicker; this is a matter of great importance, as the whitening, &c. cannot be done without reducing the thickness of the leather, and otherwise impairing its quality where it is already deficient.

What we claim as our discovery, and desire to secure by letters patent, is the saving the labour of once whitening, boarding, and stoning in all kinds of upper leather, also avoiding the use of tallow, and simply using oil in its stead.

ADAM HICKMAN.
EDWIN L. DAVENPORT.

Specification of a patent for a new mode of protecting Bank Notes, Bills of Credit, &c., from alteration; granted to EBENEZER WATSON, *city of Albany, New York, August* 3, 1838.

To all whom it may concern: Be it known, that I, Ebenezer Watson, of the city of Albany, in the state of New York, have invented a new mode of protection against the alteration of Bank Notes, Bills of Credit, Circulating Notes, Certificates of Stock, and other instruments of writing, by any change of the sum thereof; and I do declare that the following is a full and exact description.

The nature of my invention consists in engraving, printing, or otherwise expressing, the sum in large letters, words, or figures, on the face of the note, &c., and so disposing the words, or other matter, of the body of the note, &c., as therewith to fill up the spaces between such large letters, words, or figures, and between the parts thereof, but not to cover such letters, words, or figures, or the parts thereof, either in whole or in part.

EBENEZER WATSON.

Specification of a patent for an improved mode of manufacturing Ploughs of Cast Iron; granted to CYRUS ALGER, *city of Boston, Massachusetts, August* 3, 1839.

To all whom it may concern: Be it known, that I, Cyrus Alger, of the city of Boston, in the state of Massachusetts, have invented a new and improved mode of manufacturing Ploughs; which improvement is applicable to all the various kinds and forms of Ploughs which are made of Cast Iron, and I do hereby declare that the following is a full and exact description thereof.

The nature of my invention consists in the giving to the iron work of the whole body of the Plough, consisting of the mould board, land-side, share, movable, or permanent points, and other parts requiring it, that malleability which allows of their being altered in shape, in the same way in which wrought iron may be altered, and at the same time giving to all the cutting edges, and to such other parts as from their exposure to wear may require it, the necessary degree of hardness and temper, and the capability of being softened, drawn out, and again hardened and tempered, whenever it may be desired.

I cast the respective parts of the plough to be made, of iron, from any of the known patterns, and I then subject these parts to the well known process of annealing, by which cast iron is rendered malleable; having carried this process to the necessary extent, by which the iron is brought into that state in which it is susceptible of being hardened and tempered like steel. I then harden such of the cutting edges, and other operating parts, as may require it, and temper the same, in the manner in which steel is ordinarily hardened and tempered. I thus obtain a plough which, whilst it can be manufactured at but little cost, will possess all the useful properties of a plough the body of which is made of wrought iron, and its cutting edges and points, and such other parts as are most subject to wear, laid with steel.

Whilst I lay no claim whatever to the process of rendering cast iron malleable, or to any improvement in the general form or construction of the plough, I do claim the manufacture of ploughs from malleable cast iron, with such parts as may require it hardened and tempered, as steel is hardened and tempered; such being to the best of my knowledge and belief, an entirely new manufacture, producing results which are highly beneficial, and not heretofore produced by analogous means. CYRUS ALGER.

Specification of a patent for Generating Steam by bringing water into contact with hot or boiling oil, or grease; granted to HORATIO HUBBELL, *city of Philadelphia, August* 6, 1839.

The nature of my improvement or invention consists in applying to steam engines a mode of instantaneously generating steam by bringing water of the common temperature into contact with hot or boiling oil, or hot or boiling grease; the steam so generated to be applied as the moving power of the steam engine. The words "common temperature" are used as aforesaid, because water of that temperature is the kind proposed to be used, is fully adequate to the effects designed, and is most economical; but at the same time the effect can be produced as long as the water is inferior in temperature to oil, the oil being heated above the boiling point of water, or up to that point. The boiling point of oil or grease being above that of water, or, *vice versa*, that of water being below that of oil or grease, by bringing water in contact with oil or grease heated above the boiling point of water, steam is instantaneously generated. The point to which the oil or grease is intended to be kept heated is at, or near, the boiling point of oil, since the hotter the oil the more rapid and complete the action upon the water. The oil (whale oil is perhaps most convenient and best,) is to be introduced into copper, brass, or other suitable steam tight metallic cylinders, boilers, generators, or vessels. The quantity of oil to be introduced is to be regulated by the capacity of the cylinders, &c., the bottom of which it ought to cover to some depth, so as to have a good body of oil; generally, filling about a fourth of the cylinder, &c., will be sufficient, though there may be more. The oil may be introduced into the cylinder by means of a stop cock with a funnel head, the cock being placed or inserted at the side of the cylinder, so as to be on a level with the upper surface of the oil. The oil so introduced having been heated above the boiling point of water by a fire conveniently applied to said cylinder, boiler, generator, or other suitable vessel, so as to gradually fall upon the surface of the oil, or so as to come into contact with the oil at or beneath its surface. The reservoir here spoken of, is intended, in general, to be a large basin placed on a level with the top of the cylinder, &c., the pipe passing from the basin to the cylinder.

The said pipe or pipes to let water into the cylinder are to be provided with one or more valves, shutting outwards, so as to prevent the steam after it is generated, from escaping through them, while by opening inwards they admit the water. The bore or caliber of the pipe or pipes may be so contracted as to let the water into the oil continuously, but very slowly and gradually, or the pipe being more free in its bore may have its water let into the oil, or shut out, by means of a cock constructed so as to open and shut at alternate intervals, by means of an eccentric, and the working of the engine; or the said pipe or pipes may be connected with pumps such as are now used to force the water into common boilers; but still care must be taken so to construct them as to introduce the water gradually, and by measure, to the hot or boiling oil, as is done in the former cases. The quantity of water to be let into the hot or boiling oil is to be regulated by the quantity of oil employed, and the extent of its surface, and the necessity of generating a greater or less quantity of steam, care being always taken not to drown the oil by throwing in too profuse a quantity of water upon it, and thereby produce a dangerous explosion. The pipes aforesaid may pass directly through the sides of the cylinder, &c., to the oil, or entering at the top may be carried down from the top of the cylinder, &c., along the inside of the cylinder till it reaches the oil.

The heat of the oil in the cylinder may be ascertained and regulated by the application of the thermometer, to a hollow, bulbed, or funnel-headed stop cock inserted in the side of the generating vessel, so as to let a quantity of the heated oil pass out at any time into the funnel head; this cock may be also used for introducing the oil. The oil may be drawn off from the generating vessel by means of a stop cock inserted in the bottom.

As the steam is thus generated, it is applied to, and let off from, a piston working in a steam tight cylinder by means of the sliding valve worked by an eccentric, as is now done in high pressure steam engines.

In the foregoing specification, I claim as my own invention and discovery, the application to the steam engine, of the mode of instantaneously generating steam by bringing water of the common temperature in contact with hot or boiling oil, or hot or boiling grease. HORATIO HUBBELL.

Remarks by the Editor.—We have not inserted the foregoing specification with the expectation of making known a valuable improvement in the generating of steam, but as a sample of those hypothetical contrivances which are not unfrequently made the subjects of patents by persons of speculative ingenuity, but who are not under the guidance either of correct theoretical knowledge of, or of a practical acquaintance with, the subject upon which they speculate; the possession of either of these would, we are well assured, have arrested the foregoing. We are not informed by the patentee what benefit he anticipates from his invention; it certainly could not have been security from explosion, where water and boiling oil are to be brought into contact, and where it is proposed to introduce the former under the surface of the latter. If the inventor had manipulated with boiling oil, he would have been aware of the danger arising from the contact of water with it. It would be scarcely possible to find two substances more ready to quarrel together, and to become involved in a dangerous broil, if brought into intimate connexion; besides, were there no danger resulting from their contact, oil would be one of the least suitable articles that could be chosen for transferring its heat rapidly to water, as it is a bad conductor of heat, while such a transfer would require a very good one. In case of fire, and but few articles are better calculated to produce this than boiling oil, the whole contents of the boiler would administer, most energetically, to its destructive effects; gunpowder would be something worse, but not a great deal.

The specification is throughout extremely indefinite, every thing in it, except the using of heated oil or grease, being contingent, and no one practical mode of carrying the matter into operation being presented; in the present case, this is a thing of little importance, as the plan never will be adopted by any sane engineer, and the fact is mentioned merely to remind applicants for patents, of the necessity, in all cases, of presenting their inventions in such a form as shall enable any skillful workmen to carry the plan into operation.

Specification of a Patent for an improvement in the mode of preserving timber; granted to Samuel Ringgold *of Florida, and* Edward Earle, *of Savannah, in the State of Georgia, August 6th,* 1838.

The nature of our invention consists in applying heat, by boiling in strong lime water, to the interior as well as to the exterior of timber, according to the size and kind of timber, and the use in which it is to be employed may admit, or require, for the destruction and prevention of worms in it, and for the correction or removal of the corruptible sap, and the occupation of its place by a preservative substance.

We first bore the timber, if it be of a size sufficient to admit of it, through the centre, making the perforation of a caliber proportioned to the size of the piece, say from half an inch to an inch and a half, or two inches. Then we boil it in strong lime water for a length of time proportioned to its size, as four to six hours, if it be twelve inches square, and so in proportion to its substance; and when the timber has had the heat and fluid conveyed through its whole substance, it is to be removed to a shed, where, protected from the sun and wind, it may gradually dry. Finally, before it is used, the perforation through the centre is to be completely filled with dry lime, or with petroleum, or coal tar, as the purpose for which it is intended may make preferable, and plugged by wood of the same kind, and prepared in the same manner. Also, if the use to which the timber is destined be such as to admit of it, the exterior may be payed, or coated with hot petroleum, or coal tar.

What we claim as our invention, and desire to secure by letters patent, is the boiling of timber in lime water, as above set forth. We apply the fluid to the interior as well as exterior of the timber, by means of the central perforation, when the size of the timber requires it, as the most effectual mode of preserving it from the ravages of insects, and from rot. We do not claim the saturating of timber by a solution of lime in water when applied cold, or when heated by that heat which is generated in the slacking of the lime, but confine our claim to the boiling it in lime water during one, two, three, or more hours.

Samuel Ringgold.
Edward Earle.

Remarks by the Editor.—The plan of impregnating timber with lime, by soaking it in lime water is quite old, but we have never yet seen any evidence of its utility. This is an assumed effect, but one which, we believe, yet remains to be proved. The only substantial difference in the plan above proposed, and that formerly essayed, is in the boiling process, and this we think of very doubtful utility. Timber may be rapidly seasoned by boiling, the moisture within it being converted into vapour, and consequently escaping through the pores, a condition not the most favourable to the entrance of a solution; the allowing it to cool in and with the liquor might probably promote saturation. There is another fact of some importance in the process, provided the thing itself is of any value, namely, that the colder the water the greater is the quantity of lime held in solution, and of course more would enter the pores in a cold than in a heated vessel. It is not worth while, however, to extend our speculations upon the best mode of getting the lime in until we have ascertained the fact that when it is there it will produce some good result.

Specification of a Patent for preparing the Lignia, or fibrous portion of Corn Husks, so as to be a suitable base for Paper, and oxalic acid; granted to Homer Holland, Westfield, Hampden County, Massachusetts, August 13th, 1838.

The corn husk consists of two distinct substances, viz: lignia, and mucilage. The lignia, or fibrous portion, is similar to the fibrous portion of hemp or flax, and must be completely freed from the mucilage before it can be bleached. By making it susceptible of perfect bleaching, without destroying the strength of the fibre, it may be used for valuable purposes.

The nature of my invention consists in making the mucilaginous portion of the husks soft and soluble by means of alkaline solutions, so as to be readily removed by washing and beating, leaving the fibre strong and capable of being perfectly bleached.

I adopt the following method of applying the alkaline solutions. The husks, properly selected and cleaned, are to be macerated for several hours in a moderate solution of carbonated alkali, in any convenient kettle, caldron, tub, or vat, which may be kept warm by fuel or steam. After having been thus macerated, sufficient of hydrate of lime is to be added to combine with the carbonic acid of the alkali, and render it caustic, so as to dissolve the mucilage, and the whole is to be boiled from one to two hours. The mucilage of the husk is thus converted into a soluble umate of the alkalies employed, and in this state may be removed from the lignia or fibre, by washing in several waters, rubbing, and scouring. If the husk be thus treated the lignia is strong, and if the washing, beating, and scouring be suitable, the fibre may be completely separated, and may be perfectly bleached by an alkaline chloride, or sesqui-chloride, in solution, or by any of the known and appropriate processes of bleaching. The lignia or fibre thus prepared may be used as a substitute for sugar or starch in making oxalic acid, and after being rendered even, if necessary, by rolling or pressing, may be manufactured into paper in the same manner as the ordinary fibre from rags.

What I claim and desire to secure by letters patent, is the process of macerating the husks of corn for several hours in a solution of a carbonated alkali, and then rendering the alkali caustic by adding the hydrate of lime, and boiling for one or two hours, as above described, in order to produce a strong and bleachable lignia, or fibre, for the manufacture of paper, of oxalic acid, and for other purposes. HOMER HOLLAND.

Remarks by the Editor.—The only novelty in the process above described, is that of rendering the alkali caustic, by the application of quick lime, after the husks have been macerated; the other steps have all been taken in the manufacturing of paper from straw, and other materials; to what extent this part of the process is of utility is a practical question, concerning which we are not informed; all we know respecting it is, that it is in the hands of a gentleman of much skill and experience, and who had, therefore, undoubtedly satisfied himself of the utility of the plan before presenting it for a patent.

SPECIFICATIONS OF ENGLISH PATENTS.

Specification of a patent granted to FREDERICK JOSEPH BURNETT, *of the city of London, and* HIPPOLYTE FRANCOIS MARQUIS DE BOUFFET MONTAUBAN, *of Chelsea, in the county of Middlesex, for certain improvements in the manufacture of Soap, being a communication from a foreigner residing abroad. Sealed 4th July*, 1838.

The object of this invention is to make or manufacture soap from refuse animal matters, which have not hitherto been used for such purpose, whereby such matters which have heretofore been thrown aside for manure, or put to little use, are made available to a better and more useful purpose; and consists in making or manufacturing soap from the intestines of animals and other gelatinous or fibrinous parts of animals, and also of fish, which have not before been used for such purposes. Such intestines or other gelatinous or fibrinous materials being subject to processes whereby caustic alkali is made to act upon the said materials, and produce saponification, and convert the same into soap.

And previously to describing the mode, manner, or method and processes of treating or operating upon such refuse animal substances, we will first state that we are well aware that all animal and vegetable oily and fatty materials have long been employed in the manufacture of soap; and also, that caustic alkali has been used in such manufacture, for producing saponification, and converting the said fatty materials into soap; and, therefore, we hereby disclaim the use of all fatty or oily matters extracted from animal or vegetable bodies in the process of manufacturing soap, saving and except when used in conjunction with the refuse animal, gelatinous, and fibrinous materials, as hereinafter described; that is to say, when such animal or vegetable fatty matters are used in small proportions, mixed with the said refuse animal matter after being acted upon by the alkali, for the purpose of producing a better quality of soap than the said refuse animal matters would make when used by themselves.

And we will now proceed to describe the process, manner, or method of treating the said animal, gelatinous, or fibrinous matters, and converting the same into soap, stating the process which we have employed, and found to answer well for this purpose when treating upon the intestines of animals. That is to say, the intestines, after being well washed or cleansed, are placed in proper vessels, and immersed in a ley of caustic soda or alkali, in order to prevent their decomposition until they are wanted for use. The quantity of this ley, in proportion to the mass of intestines, must vary according to circumstances; we have found seven or eight per cent. of alkali, to the quantity of materials under operation, to answer well. The animal matters are to remain in the tubs or vessels seven or eight days, or until the alkaline solution is absorbed, and a partial saponification has commenced. When the intestines are required for use, they are to be carefully washed, and well drained or partially dried on hurdles or nets, after the manner that feltmongers treat their materials; after which, the animal matters are to be placed in a copper or other suitable vessel containing a solution of caustic alkali. This caustic ley is to be made warm during the time required to produce the entire saponification of the materials: the fire used in this operation or process should be slow, if applied direct to the copper or other vessel, as the materials ought never to be allowed to boil. This is easily prevented, after a few trials have been made and the proper precautions used, which practice will show; but if the copper or other vessel containing the materials is heated by means of steam or hot water, in the way it is commonly applied in various operations and manufactures, then these precautions will not be required, as the alkaline ley will never boil if the apparatus is properly arranged and constructed. After the saponification has taken place, the soap is to be poured into moulds to give the required shape of the cakes, and allowed to cool, and, when hard, is ready for use.

We should here observe, that this soap contains, in its primitive matters, a large proportion of water, and, therefore, dries with greater difficulty than common soap. If it is desired to obtain a hard soap, it is necessary to add into the copper or other vessel, after a few hours of the above operations, a sufficient quantity of barras or gallipot, or other resinous matter, which will give it solidity. It is difficult to indicate or name the precise quantity of materials to be used in these processes, because the intestines have more or less fatty substances or materials commingled with them; but a few days' practice and experiments will show this better than any stated proportion. When it is wished to obtain a whiter soap, it is necessary, as soon as the saponification is finished (and no gallipot has been used), to mix in the copper a proper quantity of chloride of soda or other bleaching matter, the whole mass of materials being well agitated or stirred during a proper time, and the result will be as desired.

It is important to notice that the ley or solution of caustic alkali is incorporated with the animal matters, and therefore a superabundance of water cannot be drawn or pressed out of the materials after saponification, as is the case in the ordinary manufacture of soap from fatty materials; and we would further remark, that the saponification of the gelatinous or fibrinous matters is a rather delicate process, and, therefore, requires attention. The difference of temperature or climate, and the proportion of fatty matters which the intestines contain, ought to determine, in some degree, the proportion of alkali used, and the modification of the dose of the ley, all of which will be readily suggested by any practical soap manufacturer or chemist. We should here mention, that in order to introduce the barras or gallipot, or other resinous matters into the soap, it is necessary to dissolve it in the ley or alkaline solution, or in the fatty materials, to be afterwards incorporated with the soap when it is required to produce a better quality. We have named the above substances because they, being of a whitish hue, will give less colour to the soap than common rosin; but if the colour of the soap is not material, then rosin may be used to harden it.

Having now described the process and manner or method of operating and treating the refuse animal materials in producing the effect of this invention or discovery, we would remark that the same applies to all gelatinous and fibrinous animal matters not hitherto used in soap-making, the intestines, refuse pieces of skin, sinews, muscles, fleshy or fibrinous parts, horns, hoofs, all kinds of fish and gelatinous animal matters which cannot be put to a better purpose; the only difference of treatment being, that these different matters will require different proportions of the alkaline solution and different periods of operation, all of which will be found by practice when treating these matters, as above described.

And, in conclusion, we would remark that the caustic alkali solution or ley above named, in both the first and second processes, may be formed with water and the common soda of commerce, pearl ashes, or barilla, caustic lime, or a mixture of all or some of these alkalies; therefore, we do not mean or intend to confine ourselves to alkali in any particular state, or to any particular proportion thereof, nor to any particular time the materials are to be kept under operation, as these must vary according to the quality of the materials to be operated upon: remarking that these processes, manner or methods of treating the above named gelatinous or fibrinous matters, do not, nor are they intended to apply to the making of soap from animal, fatty, or oily matters, as the same is not at all applicable to the making of soap from such materials alone; and when such fatty matters are added thereto, it is only to produce a soap of better quality or appearance than can be made by the gelatinous and fibrous matters alone.

And, finally, we would state, that what we claim under the above in part recited Letters Patent, is the making or manufacturing of soap with the above-mentioned refuse-animal, gelatinous, and fibrinous matters, by treating or operating upon them, and producing saponification therein by means of the caustic alkaline leys or solution, in the manner or method above set forth and described. Lond. Jour. Arts & Sci.

Specification of a patent granted to EDWARD HEARD, *of the county of Middlesex, for his invention of certain improvements in oxydizing Lead, and converting the same into pigments, or white and red lead, and manufacturing part of the products arising from these processes into Soda. Sealed 1st August,* 1838.

The Patentee describes his invention in the following manner:—I take any known weight of lead and melt it in a reverberatory furnace: to the melted lead I add about half its weight of a salt called nitrate of soda, throwing in small quantities at a time, and stirring it well in order to mix it with the fused metal. When the whole of the salt is thus put into the furnace, it is kept continually stirred until the lead entirely loses its lustre and metallic appearance, which takes place by exposure to a low red heat, in the course of a few hours, and becomes converted into a protoxide of lead resembling, in colour, litharge.

When it has attained this state, the charge is withdrawn from the furnace and cast in moulds to consolidate, or spread on a clean stone floor to get cold.

It is next ground to a very fine powder, and if intended for the manufacture of white lead, it is put into a large vat close covered, and mixed with water to about the consistence of thick cream. Into this mass a current of carbonic acid gas is directed, and agitation kept up until the protoxide of lead is converted into carbonate of lead.

This should be well washed, and the saline solutions mixed together and evaporated to dryness. The salts thus obtained, consisting of a mixture of sub-carbonate and nitrate of soda, may be used again two or three times successively when thus recovered with fresh portions of lead, taking care that the metal employed is about double the weight of the saline matter in each charge.

When the whole of the nitrate of soda is decomposed by these successive operations, it is lastly conveyed into an alkali furnace, and there finished with carbonaceous matter; the alkaline salt is then lixiviated, and the solutions mixed and evaporated to dryness, or brought to such a specific gravity as will, under proper circumstances, cause it to form crystals of carbonate of soda, according to the views of the operator: thus white lead and carbonate of soda are produced.

When the object is to manufacture *red lead*, the protoxide of lead above mentioned, as being produced by the first process of oxydation, when taken out of the furnace and cold, is ground fine and put into a vat, where it is repeatedly washed until all saline matter is separated; this latter being reserved for future operations: the protoxide of lead thus purified, is then removed into a red lead furnace, such as are in common use, and there finished in the usual manner. Ibid.

Progress of Practical and Theoretical Mechanics and Chemistry.

A Statistical View of the recent Progress and present Amount of Mining Industry in France; drawn from the Official Reports of the "Direction Générale des Ponts et Chaussées et des Mines." By G. R. Porter, Esq. F. R. S.

(Concluded from p. 35.)

Iron.—At the present time France occupies the second rank among nations as regards the production of iron, England being still immeasurably in advance of France, in which country the extension of this branch of industry is far less than has been effected of late years with us.

There are at this time in France 12 distinct localities or districts, in which the making of iron is prosecuted. The processes employed for the conversion of the ore in these different sets or groups of iron-works differ materially from each other, in respect of the different kinds of fuel employed for the purpose. May it not be owing in a great measure to this circumstance, that improvements in the manufacture have hitherto made a very slow progress in that country? The improvement applicable to the process where one kind of fuel is used may be inapplicable to works where another kind of fuel is consumed, and it will therefore probably be confined to the spot in which it is originated. If the processes used for the conversion of the ore had been identical at first, it would not have been possible thus to limit improvements, which, in whatever district they had begun, must have been adopted throughout the country as speedily as the requisite knowledge could be diffused or the needful apparatus obtained.

The 12 distinct districts in which the making of iron is prosecuted in France are thus distinguished in the official reports:—

	DEPARTMENTS.
1. Group of the North-east,	Ardennes, Moselle, Meuse.
2. " of the North-west,	Eure, Orne, Mayenne, Morbihan. Sarthe, Loire Inférieure, Côte du Nord, Eure et Loir, Ille et

		Vilaine, Manche, Loir et Cher, Maine et Loire.
3.	Group of the Vosges	Bas Rhin, Vosges, Moselle.
4.	" of the Jura	Côte d'Or, Haute Saône, Doubs, Jura.
5.	" of Champagne and Burgundy,	Côte d'Or, Haute Marne, Vosges, Meuse, Marne, Aube, Yonne.
	" of the Centre	Nièvre, Cher, Allier, Saône et Loir.
	" of the Indre and la Vendée	Vendée, Indre, Cher, Vienne, Indre et Loire, Loir et Cher, Haute Vienne.
8.	" of the coal-fields of the South,	Creuse, Puy-de-Dóme, Cantal, Aveyron, Gard, Ardèche, Loire, Isere, Ain.
9.	" of Périgord	Charente, Dorgogne, Lot et Garonne, Tarn et Garonne, Corrèze, Haute Vienne.
10.	" of the Alps	Dróme, Isère, Hautes Alpes, Vaucluse.
11.	" of the Landes	Landes, Gironde, Lot et Garonne.
12.	" of the Pyrenees	Basses Pyrénées, Hautes Pyrénées, Arriége, Aude, Pyrénées Orientales, Hérault, Tarn.

The actual and relative importance of these groups may be seen from the following particulars, given in the Report presented in the present year, and having reference to the working of 1836:—

Group.	No. of Iron Works	No. of Work-men.	Quantity of fuel in tons & steres.				Quantity of Products.			Value of Products in English Money.
			Wood Charcoal.	Coke.	Coal.	Wood.	Cast Iron	Bar Iron.	Steel.	
			Tons.	Tons.	Tons.	Steres	Tons.	Tons.	Tons.	£
1	94	2,233	90,884	3,530	8,230	33,583	46,233	30,450	162	530,599
2	59	1,771	54,051	..	2.964	..	23,755	11,182	..	210,238
3	7	388	..	7,315	24,830	..	2,226	9,189	..	147,500
4	148	2,090	126,754	..	910	..	54,737	28,900	581	652,030
5	152	2,807	139,602	..	40,947	..	81,499	42,309	..	691,528
6	124	2,133	71,098	14,094	35,798	..	36,993	27,029	766	501,362
7	21	499	17,564	..	..	..	5,824	2,870	..	61,085
8	15	1,243	..	87,444	115,038	..	28,440	27,276	..	377,158
9	115	1,175	39,120	..	3,399	..	14,893	9,064	96	173,646
10	39	174	6,614	..	251	..	2,021	282	1,120	6,916
11	21	410	17,466	..	32	478	7,118	3,674	..	62,535
12	99	815	30,742	..	..	..	..	9,466	..	171,140
	894	15,738	593,855	112,383	232,399	34,061	303,739	201,691	2,725	3,585,739

The figures given in the foregoing table do not present in all their importance the extent of this branch of industry in France. The number of workmen employed for the production of pig-iron *(fonte)*, malleable iron *(gros fer)*, and steel, which alone are there included, does not much exceed one-third of the number engaged in all the various processes of the iron manufacture; and the total value of the material produced, instead of being, as in the above statement, £3,585,739, amounted in 1836, according to the returns of the inspectors, to £4,975,424. The following abstract contains all that it appears desirable to offer on this occasion, and presents under five principal divisions the total number of workmen engaged in the manufacture, with the value created by them in each of those divisions:—

	Number of Workmen.	Value Created.
1. Extraction and Preparation of the Ore . .	17,557	£500,632
2. Production of Pig-Iron *(fonte)*	6,776	1,969,132
3. Production of Malleable Iron *(gros fer)* .	8,678	1,506,247
4. Founding, Drawing, Rolling, &c.	8,615	812,486
5. Converting, Moulding, Casting, &c. Steel .	2,149	186,927
Total,	43,775	£4,975,424

Rather more than 40 per cent. of the value here stated is made up of the cost of the fuel used in the various processes, viz:—

Wood Charcoal	£1,643,826
Wood	13,040
Coke	96,972
Coal	285,235
Peat . . . . . , .	694
	£2,039,767

This sum is divided among the different processes in the following proportions:—

	£	Decimal Proportion.
1. Roasting the Ore	1,782	0.087
2. Smelting	1,132,039	55.500
3. Refining, Puddling Furnaces, &c.,	737,888	36.175
4. Casting, Drawing, Rolling, &c.	121,556	5.959
5. Moulding, Casting, &c. Steel .	46,502	2.279
Total, . .	2,039,767	100.000

It will be seen that four-fifths in value of the fuel is composed of wood. Coke was not used in the iron-works of France until 1821, and at the present time is employed almost exclusively for processes subsequent to smelting the ore. The proportionate value of different kinds of fuel consumed in the various processes, in each year from 1833 to 1836, has been,—

	1833	1834	1835	1836
Wood Charcoal	0.838	0.818	0.864	0.806
Coal	0.098	0.129	0.098	0.140
Coke	0.062	0.050	0.037	0.048
Wood	0.002	0.003	0.001	0.006
	1.000	1.000	1.000	1.000

The average prices of the different kinds of fuel in 1836, as stated in the Report, were—

Wood Charcoal . .	54*s.*	10*d.*	per ton.
Coal	18	5	“
Coke	20	3	“
Wood	2	10	per stere.

The increased proportion of wood, observable in the working of 1836, is caused by the substitution in part, in some works, of wood dried by heat or partially carbonized.

By the introduction of a proportion of dry wood in place of charcoal, a diminution in the cost of fuel has been attained; but against this advantage must be placed the smaller produce obtained from the furnace in a given time, as well as a diminution of metal from a given quantity of ore.

Where wood charcoal alone is used for smelting, it requires eighteen metrical quintals for the production of thirteen metrical quintals of iron. Where coke and coal are used in the proportion of ten of the former to nine of the latter, it requires about three quintals of fuel to produce one quintal of iron. In some cases, coke is used with charcoal in the proportion of one quintal of coke to two quintals of charcoal, and the produce has been eight quintals of iron for ten quintals of fuel. In the first case, (where wood charcoal is used,) the cost of the fuel has been 9.92 fr. per metrical quintal of iron, or 4*l.* 0*s.* 6*d.* per English ton. The cost when coke and coal are used, is stated to be 4.45 fr. per quintal, or 36*s.* 1½*d.* per ton; and in the third case, where coke and charcoal are mixed, the cost is said to be 7.60 fr. per quintal, or 3*l.* 1*s.* 8*d.* per ton. The value assigned to the produce is,—

In the first case,	20.99 fr. per quintal, equal to	£8	10	4	per ton.
In the second case,	11.13 fr. “ “	4	10	4	“
In the third case,	20.32 fr. “ “	8	4	11	“

The mixture of coke and charcoal would, upon the whole, appear to be the most profitable in its result. Deducting from the value of the metal the sum expended for fuel, there would remain, when charcoal alone is used, 4*l.* 9*s.* 10*d.* per ton; when coal and coke are used 2*l.* 14*s.* 2½*d.* per ton, and when coke and charcoal are used 5*l.* 3*s.* 3*d.* per ton. These calculations are of course wholly inapplicable to the circumstances in which the manufacture is placed in this country from the actual and relative cheapness of our mineral fuel.

The use of the hot blast has been adopted in several of the furnaces in France. At first it was found that the iron thus obtained was not so well adapted for making bar iron as that for the smelting of which cold air had been used; but some modifications, which are not particularized in the Reports, have been introduced into the process, and this disadvantage has been remedied.

No account is given of the quantity of iron made in France earlier than 1824; but from that year the account is regularly stated in the Reports, from which the following abstract has been computed:—

Years.	Pig-Iron.	Malleable Iron	Years.	Pig-Iron.	Malleable Iron
	English Tons.	English Tons.		English Tons.	English Tons.
1824	194,636	139,564	1831	221,423	138,942
1825	195,588	141,396	1832	221,660	141,336
1826	202,756	143,336	1833	232,559	149,932
1827	213,175	146,621	1834	265,028	174,507
1828	217,604	149,117	1835	290,378	206,396
1829	213,868	151,319	1836	303,739	201,691
1830	222,965	146,242			

As in the case of coals, the importations of foreign iron into France have kept pace with the increase in the native production. The Custom House accounts of that country are detailed with great minuteness; but it is not necessary here to particularize the quantities of each description of foreign iron used in France. The value so consumed in each year since 1815, and the amount of duty collected on the same, were as follows:—

Years.	Value of Foreign Iron Imported for use.	Amount of Duty collected.	Years.	Value of Foreign Iron Imported for use.	Amount of Duty collected.
	£.	£.		£.	£.
1815	87,556	29,840	1826	218,212	130,326
1816	98,063	45,600	1827	186 846	98,960
1817	202,205	122,024	1828	179,635	95,073
1818	163,173	89,491	1829	160,625	84,396
1819	164,238	94,180	1830	187,117	100,476
1820	162,107	81,517	1831	123,185	63,644
1821	226,571	126,945	1832	159.222	82,192
1822	144,193	74,540	1833	174,601	91,569
1823	141,501	86,258	1834	200,573	104,598
1824	164,812	94,157	1835	231,208	121,346
1825	150,690	86,894	1836	252,702	122,842

The production in France of metals, other than iron, is of little or no commercial importance at the present time. The whole value created in the articles of lead and silver, antimony, copper, and manganese, amounted in 1836 to less than 60,000*l.*, and gave employment to only 1760 workmen. In noticing this fact the inspectors encourage the hope that some considerable addition may shortly be made to the produce of mining industry applied to the articles just enumerated; they do not, however, explain the grounds upon which this hope should be entertained, further than by noticing the existence in the country of several promising fields for that industry hitherto allowed to remain unproductive, and by stating that they are occupied in collecting information which may serve to facilitate the future attempts of persons desirous of embarking their energies and their capital in this direction.

Lead and Silver.—There are 11 lead-mines in operation in France, situated as under—

Hautes Alpes	2,	produced, in 1836,	46	Tons,	valued at	£1,175
Finistère	1	“	504	“	“	11,692
Gard	1	“	4	“	“	80
Isére	1	“	54	“	“	848
Loire	1	“	22	“	“	260
Lozére	1	“	47	“	“	1,316
Puy-de-Dôme	1	“	30	“	“	740
Rhône	3	“	6	“	“	98
	11		713			£16,209

The Silver obtained from the soil of France is separated from the produce of some of the lead-mines above mentioned: the quantity and value thus yielded in 1836 were,—

Hautes Alpes . . .	203	lbs.,	valued at	£660
Finistére	3,517	“	“	11,542
Lozére	1,028	“	“	3,388
Puy-de-Dôme . . .	324	“	“	1,060
	5,072			£16.650*

* The value put upon this produce in the Report is thus 5*s.* 6*d.* per oz.

The quantity of lead of native production supplies but a small part of the wants of the country. The importations into France from foreign countries, principally Spain, for consumption during the five years from 1832 to 1836, have averaged 14,800 tons per annum.

Antimony.—This mineral is produced in France from 11 mines, viz:—

Allier	1,	which produced, in 1836,	138	Tons,	valued at	£3,864
Ardéche	1	“	63	“	“	1,944
Gard	1	“	23	“	“	628
Haute-Loire	2	“	22	“	“	652
Lozére	4	“	35	“	“	960
Puy-de-Dôme	2	“	130	“	“	4,073
	11		411			£12,121

Copper.—The produce of copper-mines in France, five in number, is quite inconsiderable; three of these mines are in the department of Hautes Alpes, and two are in the department of the Rhone. The quantity of metallic copper which they yielded in 1836 was only 102 tons, and its value £7,877. The yearly consumption of foreign copper, principally the produce of Russia and of England, during the five years from 1832 to 1836, has averaged 6235 tons.

Manganese.—The manganese-mines are situated as follows:—

Allier	1,	which produced, in 1836,	365	Tons,	valued at	£1,628
Aude	1	“	148	“	“	570
Dorogne	3	“	215	“	“	951
Haute-Saône	1	“	39	“	“	31
Saône-et-Loire	1	“	900	“	“	2,926
	7 Mines.		1,667	Tons.		£6,106

The engineers to whom the task of inspecting the mining establishments of France is entrusted have not confined their enquiries to the objects which have been noticed in this paper: they have included in their Annual Reports the statistics of various branches of industry in which mineral substances are produced or employed; such as bituminous minerals—alum—sulphate of iron—and salt; the produce of quarries—of glass-houses—of porcelain and pottery manufacturies—of copper and zinc works—and of chemical processes. By this means, it is shewn that the number of workmen who in 1836 depended for subsistence upon mining operations and their consequences, amounted to 273,364, while the total value created by their joint labour amounted to 377,684,791 fr., or £15,107,392, viz:—

	Establishments.	Workmen.	Value created.
			Francs.
Coal, Lignite, Anthracite, and Peat, .	2,219	55,735	30,533,922
Iron and Steel, ...	..	43,775	124,385,616
Lead, Silver, Copper, Antimony, Manganese,	..	1,760	1,476,161
Bitumens, ...	6	245	192,128
Alum and Sulphate of Iron, . . .	19	1,141	1,760,667
Salt, ...	..	16,615	10,397,164
Quarries, ...	..	70,396	40,350,419
Glass Manufactures, ...	..	10,497	47,474,301
Porcelain, Pottery, and Earthenware, .	..	20,480	27,418,122
Bricks and Tiles, and Lime, ...	..	44,604	51,939,239
Plaster, ...	..	4,298	14,713,796
Chemical Products, ...	..	2,216	22,043,732
Copper, Zinc, and Lead Works, . .	..	1,597	4,999,524
		273,364	377,684,791

Jour. Statis. Soc.

Note on the Art of Photography, or the Application of the Chemical Rays of Light to the Purposes of Pictorial Representation. By Sir John F. W. Herschel, Bart., K. H., V. P. R. S., &c.

The author states that his attention was first called to the subject of M. Daguerre's concealed photographic processes, by a note from Captain Beaufort, dated the 22nd of January last, at which time he was ignorant that it had been considered by Mr. Talbot, or by any one in this country. As an enigma to be solved, a variety of processes at once presented themselves, of which the most promising are the following: 1st, the so-called de-oxidizing power of the chemical rays in their action on recently precipitated chloride of silver; 2ndly, the instant and copious precipitation of a mixture of a solution of muriate of platina and lime-water by solar light, forming an insoluble compound, which might afterwards be blackened by a variety of agents; 3rdly, the reduction of gold in contact with deoxidizing agents; and, 4thly, the decomposition of an argentine compound soluble in water, exposed to light in an atmosphere of peroxide of chlorine, either pure or diluted.

Confining his attention, in the present notice, to the employment of chloride of silver, the author inquires into the methods by which the blackened traces can be preserved, which may be effected, he observes, by the application of any liquid capable of dissolving and washing off the unchanged chloride, but of leaving the reduced, or oxide of silver, untouched. These conditions are best fulfilled by the liquid hyposulphites. Pure water will fix the photograph, by washing out the nitrate of silver, but the tint of the picture resulting is brick-red; but the black colour may be restored by washing it over with a weak solution of hyposulphite of ammonia.

The author found that paper impregnated with the chloride of silver was only slightly susceptible to the influence of light; but an accidental observation led him to the discovery of other salts of silver, in which the acid being more volatile, adheres to the base by a weak affinity, and which impart much greater sensibility to the paper on which they are applied; such as the carbonate, the nitrate, and the acetate. The nitrate requires to be perfectly neutral; for the least excess of acid lowers in a remarkable degree, its susceptibility.

In the application of photographic processes to the copying of engravings or drawings, many precautions, and minute attention to a number of apparently trivial, but really important, circumstances, are required to ensure success. In the first transfers, both light and shadow, as well as right and left, are the reverse of the original: and to operate a second transfer, or by a double inversion to reproduce the original effect, is a matter of infinitely greater difficulty; and in which the author has only recently ascertained the cause of former failures, and the remedy to be applied.

It was during the prosecution of these experiments that the author was led to notice some remarkable facts relating to the action of the chemical rays. He ascertained that, contrary to the prevailing opinion, the chemical action of light is by no means proportional to the quantity of violet rays transmitted, or even to the general tendency of the tint to the violet end of the spectrum: and his experiments lead to the conclusion that, in the same manner as media have been ascertained to have relations *sui generis* to the calorific rays, not regulated by their relations to the rays of illumination and of colour, they have also specific relations to the chemical spectrum, different from those they bear to the other kinds of spectra. For the successful prosecution of this curious investigation, the first step must consist in the minute examination of the chemical actions of all the parts of a pure spectrum, not formed by material prisms, and he points out, for that purpose, one formed in Fraunhofer's method, by the interference of the rays of light themselves in passing through gratings, and fixed by the heliostat.

He notices a curious phenomenon respecting the action of light on nitrated paper; namely, its great increase of intensity, under a certain kind of glass strongly pressed in contact with it; an effect which cannot be explained either by the reflection of light, or the presence of moisture; but which may possibly be dependent on the evolution of heat.

Twenty-three specimens of photographs, made by Sir John Herschel, accompany this paper: one, a sketch of his telescope at Slough, fixed from its image in a lens; and the rest copies of engravings and drawings, some reverse, or first transfers; and others second transfers or re-reversed pictures. Lond. and Ed. Philos. Mag.

Latanium—A New Metal.

M. Berzelius, in a letter to M. Pelouze, dated the 22nd of February, states that M. Mosander, in submitting the cerite of Bastnaes, in which cerium was met with twenty-five years ago, has discovered a new metal.

The oxide of cerium, separated from the mineral by the usual process, contains nearly two-fifths of its weight of the oxide of the new metal, merely altered by the presence of the cerium, and which, so to speak, is hidden by it. This consideration induced M. Mosander to give the new metal the name of *latane* or *latan*.

It is prepared by calcining the nitrate of cerium, mixed with nitrate of latanium. The oxide of cerium loses its solubility in weak acids; and the oxide of latanium, which is a very strong base, may be separated by nitric acid, mixed with 100 parts of water.

Oxide of latanium is not reduced by potassium; but by the action of potassium on the chloride of latanium a grey metallic powder is obtained, which oxidizes in water with the evolution of hydrogen gas, and is converted into a white hydrate.

The sulphuret of latanium may be produced by heating the oxide strongly in the vapour of oxide (sulphuret?) of carbon. It is of a pale yellow colour, decomposes water with the evolution of hydro-sulphuric acid, and is converted into a hydrate.

The oxide of latanium is of brick-red colour, which does not appear to be owing to the presence of oxide of cerium. It is converted by hot water into a white hydrate, which restores the blue colour of litmus paper reddened by an acid; it is rapidly dissolved even by very dilute acids; and when it is used in excess, it is converted into a subsalt. The salts have an astringent taste, without any mixture of sweetness; the crystals are usually of a rose-red colour. The sulphate of potash does not precipitate them, unless they are mixed with salts of cerium. When digested in a solution of hydrochlorate of ammonia, the oxide of latanium dissolves, with the evolution of ammonia. The atomic weight of latanium is smaller than that assigned to cerium; that is to say, to a mixture of the two metals.

M. Berzelius has repeated and verified the experiments of M. Mosander. —*L'Institut*, 14 *Mars*, 1839. Ibid.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

New Application of Dextrine. By BARON DE SYLVESTRE.

I have the honour to announce to the Society that I have just made a new application of Crude Dextrine in employing it as a temporary varnish for oil paintings. At the last exposition of the Saloon a great number of pictures were so confused by the imbibition of the colours, that it was impossible to appreciate them properly, and I was induced to seek for some remedy for this serious inconvenience which common varnish will not obviate, since it cannot be applied until long after the painting is finished. The nature of dextrine and the various qualities which have given it already so much extension in the arts, induced me to think that it might produce happy effects in this case, and, in fact, numerous trials have convinced me that crude dextrine, dissolved in diluted alcohol, will completely prevent the effect of imbibition, even when employed a few days after the finishing of the picture. Applied with a soft brush it gives to the whole picture a sort of clearness like a light varnish, which can be easily removed by a moist sponge, when, after a few months, common varnish may be applied with its ordinary brilliant effect, without inconvenience.

Sometimes the fat oils which have been used too freely in painting, obstruct the uniform adhesion of the solution of dextrine on the picture, and occasion the formation of small liquid drops, which, in drying, produce spots. In this case a sponge moistened with warm water must be passed over the picture to remove the first coat, and then it should be rubbed lightly with soap water previous to renewing the dextrine, which, after this, spreads uniformly over the whole picture.

The solution of dextrine, as above prepared, serves as a perfect varnish for water colours and for fixing pencil and crayon drawings, so as to prevent any injury from rubbing.

The solution of dextrine, in about an equal portion of warm water, furnishes a paste which remains liquid and possesses great energy. It may be used for drawings, engravings, and all sorts of pasteboards and paper, and as a substitute for the greater number of common pastes with decided advantage.

Rec. Soc. Poly. Juel. 1838.

Obliteration of Indelible Ink.

Marks made with this Ink may be effaced by wetting the stuff on which they are written thoroughly with liquid Ammonia. In ten minutes the colour becomes pale, and in a short time completely disappears.

The reputation of marking inks depends on the difficulty of removing from the stuff the oxide of silver, which is formed from the nitrate, the base of these inks. Ammonia dissolves this oxide without leaving a trace of its existence. Idem.

New Phosphoric Matches.

On the subject of these matches, the committee of health and safety in Paris, remark as follows, relative to their fabrication:

"Every body is acquainted with the new and elegant matches, which, on account of their convenience and cheapness, are now preferred to all others. They may be said to have totally supplanted the red matches. They inspire, it is true, some fear of danger, but when examined closely, we find this fear to be unfounded. The first matches were naturally very imperfect. They took fire on the slightest friction and sometimes on a simple exposure to the sun. It was therefore with reason that Councellor Troustrof awakened public attention to the danger of using them; and yet the fabrication of these matches has not been the less prosperous.

"The friction matches now sold may be strongly shaken in the box containing them without inflaming. They ought not certainly to be given to children as play things; but if governments were to be influenced by these considerations they must interdict the use of flint and steel, and must watch with especial care the manufactories, to prevent the sale of sulphur, sulphuric acid, burning glasses, ceruse, &c. &c, which would involve them in the ridiculous.

"Our aim in publishing this article is to enable our readers to partake in the advantages of so useful an invention, by communicating the following process. We should observe that although these matches may not be dangerous, they ought not, nevertheless, to be kept in heaps, nor should governments allow them, under any pretext, to be fabricated in the large way in a town or near dwelling houses, for the least negligence might cause a fire which could not be extinguished, and even in making them in a small way, the greatest care ought to be used.

Preparation.—Put a quantity of mucilage of gum arabic into an earthenware vessel and heat it to the temperature of 40° or 50° C. (= 100 to 125 Far.) and to four parts of the mucilage add one part of phosphorus: it instantly melts; stir it so as to mix it well with the mucilage, and when well divided, add chlorate of potash in powder, nitrate of potash and a little Benzoin, so as to form a soft paste: into this dip the ends of the match sticks. The mass constitutes what is called *fulminating tinder.* Idem.

Observations.—The Editors of the French Journal designate a number of grave accidents which have occurred in Paris in consequence of these matches, such as fires, loss of eyes, &c., and urge the expediency of an injunction, on the part of the administration, that they be manufactured in localities detached from other buildings, and if possible in fire-proof rooms, —that they be packed and sold only in separate boxes, and to recommend that no more paste be used than is sufficient for inflammation, and when transported to a distance that they be inclosed in solid cases, and the contents carefully marked as in the regulation for percussion caps.

Some prohibitory police regulations on this subject would doubtless be advisable in our cities and villages. The committee appointed by the corporation of New York to investigate the causes of fires, ascribe a number of their annual conflagrations to the imprudent use of these matches.

Of the various kinds of matches which have come under our notice, there is none which, as a medium between convenience and safety, we prefer to the Lucifers, especially as prepared by Jones, of the Strand, London, and imported by our wholesale Druggists. They require the aid of the sand paper, and scarcely one in a box will fail to ignite with its use.

We were offered lately in the streets of Pittsburgh a kind of loco-foco matches which were new to us, and were told that they are made by the cart load on the Monongahela River. A block of dry wood about one inch and a half long on each side, is sawn (but not entirely through,) in two directions, so as to leave more than a hundred detached upright pieces each the size of a match. The ends of these are dipt together in the paste, and when a match is wanted it is broken from the block. Being thus detached they can be transported with much less danger than when in compact bunches. They ignite by friction on almost any surface and burn as if containing phosphorus. The composition *may be* the same as that given in the above recipe. **G.**

Organic Chemistry. Pyrogenous products of Amber.

M. M. Pelletier and Walter state that in examining the action of heat in amber, one substance among others which they have obtained and analyzed, appears well worthy of notice.

This is a white, crystalline substance, soluble with difficulty in alcohol and ether, and acquiring an intense blue colour from the action of sulphuric acid. Their analysis leads to the formula $C^3 H^1$.

This substance has therefore the same composition as Idrialene. It exhibits also all its properties. Idrialene, discovered by M. Dumas, has hitherto been met with only in a mineral, the locality of which is lost, and which is met with only in a small number of mineralogical collections.

The authors, however, do not decide upon the identity of Idrialene and the substance they have found in amber. In case they should prove to be only isomeric, they propose to give it the name of *Succisterene.*

L'Institut, No. 235.

New Compound of the Oxide and Chloride of Antimony.

M. Langlois announces that he has just found a new compound of the oxide and chloride of antimony, which presents all the characters of a true salt, and is different from the powder of Algaroth. This oxichloride is composed of

Chloride of antimony,	13.65
Oxide of antimony,	86.35
	100.00

Idem, No. 238.

Iodide of Chromium:

The beautiful compounds of Chromium with Chlorine and Fluor have been long known, but the Iodide of Chromium has but just been obtained by M. Herbert Giraud. His method is altogether similar to that generally pursued for nitri-chloride and tri-fluoxide of chromium. Like all other compounds of the same metal, it is remarkable for its splendid colour, which is a deep granite red. It is a fluid of an oily consistence, heavier than water. Heated to 130° C. it goes off in vapour of the same colour as the liquid itself. Exposed to the air it produces aqueous fumes; mixed with water it changes into chromic and hydriodic acids. It destroys organic substances, blackens paper and wood, stains the skin with a deep, permanent brownish red, destroys the cuticle, and is poisonous to vegetables and animals. Idem, No. 241.

Filtration of Hydrogen Gas through Caoutchouc.

M. Cagniard-Latour, in experimenting on the permeability of membranous envelopes, ascertained that a small balloon of caoutchouc, well prepared, appears to be completely tight to atmospheric air; i. e. once inflated, it remained so indefinitely; but that the same bottle filled with another gas—for example, oxygen, azote, carbonic acid or hydrogen, became very sensibly loose or uninflated. With hydrogen the collapse was more prompt than with the others.

In seeking for the cause of this rapid escape of hydrogen, he filled a balloon with it, and kept it for some time under water. In a few hours, the surface was nearly covered with small gaseous bubbles, and the size of the balloon appeared sensibly diminished. On examining the gas after its escape, it appeared to be the same as before, nor had the caoutchouc membrane undergone any alteration. The result appeared to be simply the effect of mechanical filtration.

The thickness of the balloon membrane in these experiments was only the fourth of a millimetre ($= \frac{1}{1000}$ of an inch), but the author had tried others much thicker, and found that when suitably compressed, hydrogen would escape through them. Idem, No. 245.

Electricity of Friction.

Dr. Wollaston, in a memoir published in 1800, says: "To ascertain positively whether oxidation contributes to the development of electricity, I mounted a little cylinder, with cushions, and conductor, in a glass, so arranged that I could change the air it contained at pleasure. After trying its energy in common air, I substituted carbonic acid, and found that all development of electricity was suspended. It returned immediately when atmospheric air was again introduced.

In a note by Gay Lussac, on this passage, it is said: "electricity is obtained with very oxidable amalgams, in an atmosphere of carbonic acid, provided this gas is deprived of the greater part of its hygrometric water."

M. Peclet has determined, as he alleges, that Dr. Wollaston was decidedly in error. He constructed an apparatus with a cylinder, cushion and conductor, so disposed that he could introduce and discharge the gases in a dry state. With this he operated with air, hydrogen and carbonic acid, and for the two last, the experiments were not made until the containing vessel had been filled and emptied six times successively. The results were precisely the same in all the experiments. Hence he infers that in the production of electricity by friction the action of the air on the coating or amalgam, whether more or less oxidable, is without any influence.

Idem, No. 246.

In a subsequent memoir by the same author, we are told "that the production of electricity of a high tension, by the friction of slipping, by rolling, or by pressure, proceeds neither from chemical action, from shaking, (ebranlement) nor from an approximation of the molecules of a body; it results solely from contact; the increase of pressure or of motion during contact has no other effect than to increase the number of touching points, and that swiftness as well as the direction of the motion which produces separation, is without any influence." Idem, No. 247.

Zinc. Sounds Produced by Heating it.

M. Strehlke has observed some peculiarities relative to this curious phenomenon. If a spirit lamp be placed under a disc of zinc, supported from several points, or under a bar of the same metal resting on two prismatic supports, in the course of a few minutes sounds are heard somewhat like those of a chime of sleigh bells at a distance, succeeding each other rapidly. The same sounds may be produced also by cooling the metal, when heated, by covering it with a piece of ice, or better, by a freezing mixture. If the bar of zinc be laid on a table, with one end projecting over the edge, the sounds are produced by placing the alcoholic lamp under the projecting end of the bar. In this case, the noise is a sort of confused crackling.

The experiments of M. Strehlke were made on a disc of several lines in thickness, and a bar of cast zinc two feet long, sixteen lines wide and 4½ lines thick. He tried in vain to produce the same phenomenon with other metals than zinc.

Idem.

Xyloïdine.

This name was given by Braconnot some years ago, to a substance formed by the action of concentrated nitric acid on starch, lignin, and some other substances, but the particular circumstances attending its formation were not examined, nor its properties well investigated. M. Pelouse has made it the object of his study. When nitric acid, density 1.5, is added to starch, the latter, in a few minutes, disappears completely, the solution retains the yellow colour of concentrated nitric acid, and no elastic fluid is disengaged. If treated immediately by water, the xyloïdine is entirely precipitated, and the filtered fluid leaves by evaporation scarcely any re-residuum.

If instead of precipitating immediately by water, the solution be left to repose in a closed bottle, its colour passes through the various tints of a mixture of nitric acid and nitric oxide. The water in it then precipitates the xyloïdine in a gradually diminishing quantity, and in the course of two days, and sometimes in as many hours, it becomes quite clear, and regains its transparency, the xyloïdine being destroyed and transformed completely into a new acid, which is obtained by evaporation in a white mass, solid, uncrystalizable, and deliquescent, and weighing more than the starch originally dissolved. Neither carbonic nor oxalic acid is produced during the reaction.

Xyloïdine is a compound of nitric acid and starch, an atom of water in common starch being replaced by an atom of nitric acid. The whole starch is transformed into this substance, a fact which explains perfectly the increase of weight, when the xyloïdine is precipitated by water immediately after the solution of the starch in nitric acid. As an excess of this acid transforms the xyloïdine into a very soluble substance, which is no other, says M. Pelouse, than the acid I have mentioned, we have an explanation of a different result obtained by Braconnot. This chemist procured from a given weight of starch, an equal weight of xyloïdine. This evidently arose from the decomposition of a portion of the latter substance. By retarding the precipitation still longer, he would have found the impossibility of obtaining the slightest trace of xyloïdine.

When instead of leaving the solution at rest, the temperature be raised to ebullition, the starch is decomposed in a few minutes, and transformed into a deliquescent acid, which is easily obtained pure and in great quantity by evaporation in the water bath.

This acid contains no azote; it has some relation to oxalhydric acid (nitrosaccharic) but differs from it in composition. A moderate heat converts it into another acid of a dark colour, soluble in water, and from which, by the action of nitric acid, the white acid from which it was derived, may be regenerated.

Concentrated nitric acid, at a boiling heat, attacks it with the greatest difficulty. When cold, it changes it slowly into oxalic acid, without the production of carbonic acid. Hence by slow oxidation, excited by the presence of a suitable quantity of concentrated nitric acid, starch is successively converted into xyloïdine, into a deliquescent acid and into oxalic acid, without any participation of the carbon in the displacement of the other elements of these matters. These curious changes take place spontaneously in the cold in close vessels.

Xyloïdine is hence to be regarded as a kind of salt, in which the starch acts the part of a base to the acid. It is accordingly very combustible, taking fire at 180° C., and burning away rapidly without leaving any residuum. This led the author to an experiment which may be applicable to artillery. Dipping paper into nitric acid of 1.5 density, allowing it to become thoroughly penetrated, which is done in two or three minutes, and then washing it thoroughly in clean water, a kind of parchment is obtained, which is impermeable to moisture, and extremely combustible. Tissues of linen and cotton are acted upon in the same way. Idem, No. 25'.

Secretions.

According to the observations of M. L. Mandl, all the secretory organs supplied with nerves from the cerebro-spinal system give out alkaline secretions; and all the organs whose nerves are from the ganglionic system, produce an acid secretion. He remarks that the presence of a few greyish fibres proceeding from the ganglionic system, as proved by several anatomists, in the midst of cerebro-spinal nerves, may explain the small quantity of acid found in alkaline secretions, and which concur in the formation of salts in these secretions. In the same manner, he adds, the acknowledged presence of some fillets of nerves from the cerebro-spinal system, in the ganglion nerves is accompanied with a little alkali, as soda, &c., in the acid secretions. The dominant quantity of nerves, therefore, from one or the other system determines the chemical character of the secretion. One single secretion, that of the skin, makes an exception to this observation, for the sweat is acid. But my experiments induce me to hope to be able soon to resolve this difficulty; it is probable that the sweat owes its acid character to the influence of the air.

Idem.

Heat of Electricity.

Mr. Humbold presented in the name of M. Riess a memoir printed in German, containing some new experimental and analytical researches on the quantity of heat which electricity produces in metallic wires. The results are as follows:

If an electric battery is discharged through a silver wire 118.7 inches in length, through a gold wire 88.8 inches, and through a platina wire 15.5 inches; they will, when of equal thickness, experience an increase of temperature very different; but if we suppose them surrounded with ice after the discharge, they will each melt equal quantities of it in returning to their primordial temperature.

The calorific force of a metal, that is to say, the quantity of heat developed in each metal by an electric discharge, may be found by dividing the retarding electric force by its capacity (specific heat) and its specific weight.

When different metallic wires are united for the discharge of a battery, the quantity of heat developed is proportionate to the retardation which each wire produces during an electric discharge.

M. Arago observed that these results coincide in many points with those obtained by M. Peltier, in his researches on the same subject.

Idem, No. 252.

Electricity in a Vacuum.

A note being presented at the session (October 8th) from M. Masson, for the purpose of showing that, in certain conditions, the electric current did not pass through a vacuum between the poles of a strong pile, M. Arago observed that M. Savary had long ago succeeded in producing magnetization by the discharge of electricity of tension, developed by friction, and instantaneously discharged through a vacuum. For example, a glass tube, void of air, and a brass rod sensibly equal in diameter to the tube, being placed in the same circuit, the discharge magnetized needles in an equal degree, placed at the same distance from the tube and the rod. It results from this experiment, that electric motion may develope magnetism without the intervention of ponderable matters directly in its course.

Idem.

Progress of Physical Science.

Upon the alleged Influence which the Roughness and the Polish of Surfaces exercises upon the Power of Bodies to emit Heat, in reference to the Experiments of Professor Sir John Leslie. By M. Melloni.

When we measure the intensity of calorific radiation which takes place from the two sides of a metal vessel filled with boiling water, having the one of its longitudinal sides highly polished and brilliant, and the other, though at first polished, yet subsequently more or less streaked or furrowed with emery, or with the graver, or the file, we discover that the quantity of heat emitted by the streaked or unpolished surface, is always superior to that which emanates from the brilliant one. These variations sometimes exceed the ratio of two to one. Hence a deduction has been drawn, that the observed increase is owing to those inequalities which have been impressed upon the vessel, and that, consequently, the superficial asperities of bodies have the property of facilitating the exit of the heat which they contain. I beg the honour of communicating to the Academy the abstract of a series of researches, whence it seems decidedly to follow that this proposition is wholly erroneous; so that if the superficial layers clearly and decidedly contribute to make a difference in the quantity of heat emitted by a hot body, the state of the surface has no part in the production of this phenomenon.

First, I must avow that, in spite of the authority of great names, the influence of this polish in calorific emission, has always appeared to me very doubtful. It is said, the interior heat experiences in quitting the body the same action of the surface which it undergoes in penetrating it in the way of radiation. Be it so. But why should these small shining *facets* (*facettes miroitantes*) which you produce by streaking the polished plate, reflect interiorly less heat than the surface *uniformly polished?* Take a vessel of copper, having two polished sides slightly obscured by exposure to the air: make with the graver on one of these sides, a series of parallel furrows; the little furrows thus produced, will certainly be more brilliant than the rest of the vessel, and, notwithstanding, the furrowed surface will emit more heat than the smooth one.

It is now nearly two years since I imparted this objection and some other experiments of the same sort, to Messrs. Bache, Henry, and Locke, distinguished professors of physics from the United States, who were then in Paris. Now, however, that the question appears to me decided, I lay aside all indirect objections, and pass immediately to the exposition of results which conduce directly to the proof of the alleged fact.

I took a cubic vessel of copper, whose four faces were very carefully formed; externally, I soldered on its lower angles and edges, grooves provided with springs, for the purpose of supporting firmly against the vessel plates of two or three lines in thickness; and having afterwards procured two pairs of plates, one pair of jet, and the other of ivory, I applied them to the four sides. Each pair was composed of plates in every respect alike, except as it regarded the external surface, one of which was very smooth and brilliant, and the other was not polished, and was streaked with emery. On precisely measuring with the thermo-multiplier, the quantities of heat projected by the two polished faces, when the vessel was filled with hot water, and in comparing them with those which emanated from the corresponding streaked faces, I could only perceive differences to the extent of one or two hundredths (*centièmes*,) and these sometimes on the one side and sometimes on the other. The mean of twenty observations yielded only a variation which scarcely amounted to a few thousandths (*millièmes*,) and, consequently, might be altogether disregarded.

To this experiment it may perhaps be objected, that in spite of the precautions taken for the establishment of a perfect contact betwixt the plates and the vessel, we have nevertheless no certainty that the two plates which composed each of the pairs submitted to experiment, possessed the same temperature. To avoid this objection, I caused a square reservoir to be hollowed out of a small block of marble, the sides of which were reduced to a perfectly equal thickness, and the external surfaces of which were differently prepared. The first was smooth and brilliant; the second was equally smooth, but unpolished and tarnished; the third was streaked in one direction; and the fourth in two, crossed at right angles. The vessel was then filled with hot water, and *projected the same quantity of radiating caloric from each of the four sides.*

Hence, it appeared that the more or less irregular state of the surface has no influence upon the emissive power, when the radiating body is not of a metallic nature.

I then covered with lamp-black one of the faces of my marble vase, as well as one of each of the pairs of plates I had employed in the preceding experiment. As it has been agreed to represent by the number 100, the emissive power of lamp-black, I could easily determine, by successive comparisons, the proportional numbers which represented the emissive powers of ivory, jet, and marble. The whole three were found to be comprised between the numbers 93 and 98. But here might it not be said, that if in the substances which were thus employed, the influence of the unpolishing is nothing, this is owing to their emissive power reaching the limit of maximum, beyond which an augmentation can scarcely occur, because the emissive surface no longer supplies a hindrance to the escape of the heat; whilst in metals, far removed from this limit, the alteration of the state of the surface must necessarily exercise all its influence, and render it sensible by a marked variation in the quantity of caloric emitted?

Although this reasoning is based upon a pure hypothesis, viz. that lamp-black opposes no resistance to the radiation from the surface; and although the emissive powers of the three substances employed are indeed, on the one hand, so far removed from the number 100, as to permit us to appreciate the variations produced, and yet, on the other, are so energetic that the smallest proportion of change occurring in their values, would make them overcome the whole distance which separates them from this number; notwithstanding, let us for a moment abandon all these non-metallic substances, and endeavour to determine the question from the bodies themselves with which we are now more especially concerned.

Copper, zinc, tin, and tin-plate, so far as I know, are the only metals which have hitherto been employed in the experiment described at the commencement, on being exposed to the action of the air, are quickly covered with a slight film of invisible oxide, the presence of which is deduced, in a very satisfactory manner, from certain electrical phenomena. Now, it is known that the emissive power is much stronger from oxides than from the metals themselves. It may happen then, that the streaked surface, presenting a greater number of points of contact to the air, is more oxidated than the polished surface, and thus augments its radiating power by the simple effect of oxidation, without the more or less regular arrangement of the superficial parts having any thing directly to do with the result.

For ascertaining if this explanation could be maintained, all that was required was to make the experiment with gold and platina, and this I speedily did; when I found that the streaked plates of platina and gold always yielded a much more abundant calorific emission than the polished surfaces of either metal.

Oxidation then, as well as the influence of *polish in non-metallic substances*, being put out of the question, the inquiry still remains, what is the alteration peculiar to metals which, in these bodies accompanies the change, more or less considerable, of the superficial layer?

It is no other, in my opinion, than a change of hardness or of density. Jet, ivory, and marble are, in fact, substances which are almost entirely destitute of compressibility, or at all events they do not possess, in any sensible way, the property of permanently retaining the modifications of density and hardness impressed on them by the action of mechanical force. They also readily arrange themselves in the form of plates without being subjected to pressure. On the contrary, the metals are compressible; and the common metal plates of commerce are obtained, as is known, by subjecting the metals to an extremely severe pressure by means of the hammer and rollers. Finally, experiment also proves that these plates, as well as wires, have a specific weight, and a hardness superior to those of cast metal. Who is the individual that will tell us, that this augmentation of hardness and density is uniformly distributed throughout every part of the mass? Is it not, on the contrary, probable that, during this operation, the surface undergoes a pressure and condensation greater than any other part; and that the plate is truly covered by a kind of envelope, whose density and hardness is superior to that of the internal layers?

This conceded, it is evident that by streaking the surface of a plate the less dense and hard parts will be exposed. Upon turning, then, to the tables which represent the emissive powers of bodies, it will be at once perceived that these powers follow, in general, the inverse ratio of their density. Let us admit that, according to all analogy, the same law holds regarding the different degrees of condensation of the same substance, and we may hence conclude, that, in producing these small furrows at the surface of the plate, we must obtain an augmentation of the radiating power. To this we have to add, that the parts which compose the superficial layer being loosened by the separation of their contiguous particles, must become softer, and thus acquire, by the diminution of density, an emissive power which will more nearly approach to the softer layers of the interior.

This being the case, it will result, 1*st*, that a polished plate of any given metal radiates a quantity of heat so much greater in proportion as the density or the hardness of its superficial layers is less; and, 2*d*, that, in the case of inferior density and hardness, the increase of the radiating power produced by the *un*polishing will be inferior to that obtained when the plate is denser and more thoroughly compressed.

It is almost unnecessary to add, that, for the verification of these theoretic conclusions, we must avoid employing a metal which is oxidated at a low temperature, for a plate of metal of this kind is imbued with a tendency to augment its emissive power, which varies every moment with the condition of the superficial layers, and so much the more as these layers are soft and detached.

Violent percussion, on the one hand, and a very slow transition from the state of fusion to solidity, on the other, are the two means by which we succeed in endowing metallic substances with greater or less degrees of density. Accordingly, I ordered two pairs of plates to be made of very pure silver, and gave directions that one of each pair should be hammered to a high degree, and the other should be cooled down very slowly in its sandy mould. Out of these I constructed, with the addition of a metallic bottom, a small rectangular cistern, the sides of which were united by means of soft solder, so that there might be no risk of altering their densities or tempers, during the operation. When so united, the four sides were perfectly polished, which process had been accomplished by means of pumice-powder and charcoal, without the help of either the hammer or the burnisher. I then took coarse emery paper, and strongly rubbed, in one direction, one of each pair of the plates; the images of objects which appeared very distinct and bright upon the surfaces which were left in all their pristine polish were completely effaced upon the rubbed surfaces, which were quite obscure and covered with striæ. The vase, thus prepared, was filled with hot water; and the four sides, successively presented to the opening of my thermo-electrical apparatus, produced the following effects upon the galvanometer:—

The forged and polished plate, ...	10°
The forged and roughened plate, ...	18°
The cast and polished plate, ...	13°7
The cast and roughened plate, ...	11°3

In comparing these four radiations, we perceive, 1*st*, as to the *polished* plates, that the cast metal affords nearly one-third more than the forged metal; which most clearly demonstrates the influence we have assigned to the inferior density; and, 2*d*, That the effects of the streaking upon the two sorts of plates differs not only in intensity, as we had foreseen, but also in *kind*, for if the radiating power of the forged plate received an *augmentation* of four-fifths by the roughening action of the emery, on the other hand, that of the cast silver experienced a *diminution* of nearly one-fifth.

This unexpected result, which irrefragably proves the truth of our fundamental proposition, is most satisfactorily explained by the theory we have just been developing: for the pressure of a hard body, such as the emery, upon the soft surface of the cast metal, somewhat compresses and condenses the rubbed parts, and makes the bottom of the striæ, produced upon the superficial layer, harder than the whole surface of the corresponding plate.

I have to regret that I had not an opportunity of making the same experiment upon vessels of gold and platina, where the same kind of manifestations, in all probability, would exhibit themselves upon a large scale, on account of the very great difference of density we can impart to these metals by means of fusion and percussion.

And now, turning to the first observations of the late Professor Leslie, we observe that the different metallic plates which he subjected to experiment, gave constantly a greater emissive power when they were rough and irregular, than when they were smooth and polished. This being the case, nothing appeared more natural than to conclude, regarding the phenomena of the emission of caloric, that, apart from the influence dependent upon the quality of the superficial layers, there was some peculiar influence dependent upon their degree of polish, so far at least as the metals were concerned. This was the conclusion drawn from the facts observed by Mr. Leslie; and, notwithstanding, this conclusion—so simple and direct in appearance, was unwarrantable.

Here, then, is a beacon where needed, against the unfortunate precipitancy with which some experimenters hasten to dignify as general laws, the consequences which result from their first experiments. Sometimes we have only to take up an instrument and use it in some research, in order to stumble upon some new fact. But in prosecuting the work with becoming assiduity, in varying our modes of experimenting, and in analyzing the phenomenon in different aspects, it will most generally be found, either that the novelty is only apparent, and that the true explanation may be found among the already established truths of science; or if, on the other hand, it turns out to be a real discovery, it will almost invariably contradict those alleged general laws which first of all presented themselves to our minds with so much apparent certainty and clearness.—(*Comptes Rendus de l'Académie des Sciences.*

Edin. New Philos Jour.

On the Effects of Light and Air in restoring the faded Colours of the Raphael Tapestries. By MR. TRULL; *communicated by* MICHAEL FARADAY, ESQ., D. C. L., F. R. S.

To the Editors of the Philosophical Magazine and Journal.

GENTLEMEN,—You probably remember an exhibition in July last of certain Raphael Tapestries in the Haymaket, and the extraordinary effect the exposure to light and air had in restoring and altering colours which had faded during centuries of exclusion from these mighty agents. I have received letters from the proprietor, Mr. Trull, and if you think parts of them worth publication at this time, when the action of light in the service of the fine arts is so much dwelt upon, they are entirely at your service.

April 21, 1839. MICHAEL FARADAY.

To Professor Faraday.

Warwick-row, Coventry, March 12, 1839.

SIR.—The interest you took in observing the changes of colour in the Raphael Tapestries, after being exposed to light in London last July, made me anxious to communicate to you the extraordinary effects since produced, by the simple means suggested by yourself and other scientific gentlemen, of a more perfect exposure to light and air, which have for the last seven months been obtained, in a finely situated factory here.

I feared to trespass on your valuable time, but could not resist, after hearing of the great public interest now excited by the new process, called, I believe, "sun painting."

Light and air have done wonders for my tapestries, in dispelling the damp, clearing up the colours, and reproducing others, obscured by the effects of many years' close packing up in boxes. I regret not to be able to make scientific remarks on the progress of the recovery, which others acquaint-with chemistry might have done.

The results cannot fully be appreciated but by those who recollect the work when up in London, where the first effects of change unexpectedly commenced.

The greens had all become blue; you, Sir, anticipated a return to the original tints, which has, almost throughout, taken place.

The robes and full colours generally had become dull and heavy; this has gradually gone off, and left a brilliancy of colour and beauty of effect hardly to be excelled. The gold also, as you hinted, has become more clear and bright.

The flesh parts of the figures, which had become pallid, almost to white, have recovered the high tint and deep shadow, and the strong anatomical effect of Raphael.

A renewed freshness now reigns over the whole, and the clearing up of the light in many of the landscape parts is most extraordinary, giving a depth and breadth the cartoons themselves do not *now* convey, particularly in the Keys to St. Peter, St. Paul at Athens, and The Death of Ananias; where extensive landscape, ranges of buildings, and foliage have sprung up, like magic, on parts *quite obscured* when up in London eight months back, much of which is either worn or torn out of Raphael's patterns at Hampton, and painted over, and known only through the means of these Leo Tapestries.

I should have much pleasure in giving you any further information on the subject I am capable of, or in showing the works to any persons taking an interest in them. I am, &c,

WM. TRULL.

Coventry, April 17, 1839.

My former letter in regard to the extraordinary changes the Raphael Tapestries had undergone the last seven months, use as you think proper. I regret not being able to give you a scientific description from the first, and the progress; and the absence of a gentleman acquainted with the chemical effects of light and air, to have noted the changes, is much to be regretted both for science and art. The works themselves being unique, and of above three centuries, so placed for so many years in continued damp to effect such mischief to the colours, are circumstances never to occur again.

Some colours entirely changed, others in confusion and apparently gone, yet by the *mere* effects of light and air, slowly and quietly resume the chief of their original tints! Flesh reappears, hair on the head starts up; the grand muscular effect and unique power of expression, only found in Raphael and Michael Angelo, are finely developed where a few months back appeared a plain surface! *Here* are the works, and the facts may be *now* ascertained.

I have applied to the directors of the British Institution, Pall Mall, to permit one or two of these Tapestries to be exhibited with the old masters in June; thus those who saw them last year, may be able to see what they now are, and both science and art may be served; for a comparison has never yet been made, with the tapestry since the Cartoons were repaired and painted upon.

I think, Sir, you will recollect my subject of the stoning St. Stephen, the large masses of blue cloud-like appearance hanging about and over Jerusalem: these have nearly disappeared, and mountain scenery taken the place! The olive grove, which only showed a few trees in front all blue, and a heavy blue-like curtain was over all of the grove; the curtain has disappeared, and a fine deep grove is now seen; the natural green and mossy bank have nearly taken their original state; fresh lights keep breaking out and showing even deeper in the grove! and throughout the works, the original lights are working their way, from the heavier colour.

I remain, Sir, yours, &c.,

WM. TRULL.

ARTICLES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

Movements of Double Stars.

M. Mœdler advanced some researches on the probability of a normal plane of the systems of fixed stars, particularly of double stars.

There are 59 known systems of double stars, of the deviation of whose natural position there is no doubt. Among these 59 systems, 34 have a direct motion, and 25 a retrograde motion, regarding, according to general rule, N.E. and S.W. as the direct course. If all these luminaries moved in the same plane, the celestial vault would thereby be divided, relative to our sphere of observation, into two hemispheres, in one of which these visible movements would be all direct, and in the other, all retrograde. This movement will always appear the same, whatever the angle of position. We may, therefore, with certainty, and at all times, place each of those stars in one of these two classes, as soon as all doubt is removed respecting the direction of the change in their relative positions. In the poles of this plane one should see the circle of these orbits without any contraction. Under the equator they would appear to us as lines; in every other point as elipses more or less open.

At the first view, it will be perceived that, choose which division we may, both retrograde and direct movements will always remain in the same hemisphere. Researches, therefore, on this subject, can only tend to the discovery of a plane approximating as nearly as possible to the conditions announced; or, to prove that such a plane does not exist.

Now M. Mœdler has found that this plane does exist, that it cuts the terrestrial equator at about 10h. and 22h., and that it is inclined to it from 30° to 35°. He demonstrates the probability of this by various approximations. The indication will doubtless stand in need of being discussed and supported by a great number of facts.

L'Institut, No. 235.

Temperature of the Crust of the Earth in Belgium.

By an attention to the daily observations made at the new observatory in Brussels, and comparing them with those of other places, M. Quetelet has been able, as he thinks, to arrange some general propositions which include the actual state of our knowledge, derived from experiment, on the variations of the earth's temperature. They are the following:

1. In descending from the surface, the mean annual temperature gradually increases; nevertheless, immediately below the surface, at the depth of about six inches, there is a stratum whose mean temperature is a minimum.

2. The rapidity with which the annual variations of temperature are transmitted to the interior of the earth, is from 6 to 7 days through a thickness of one foot.

3. Agreeably to the deductions which theory has already pointed out, the differences of the extremes of annual temperature decrease in geometrical progression, at depths increasing in arithmetical progression.

4. The annual variations of temperature come to nothing at the depth of 60 to 75 feet; that is, at or near the stratum where the *maxima* and *minima* of the temperatures happen at the same times as at the surface of the ground.

5. In descending to the depth of several feet, in this climate, the annual variations of temperature are as the sines of the times, supposing the circumference to represent the period of the year. In high latitudes these variations do not descend so low.

6. The velocity of the descent of the *diurnal* variations is rather less than three hours through a bed of the thickness of one decimetre, (=4 inches nearly).

7. The *diurnal* variations of temperature are reduced to nothing at the depth of 13 m, 3 (=51.18 inches) or at a depth 18 times less than that of the extinction of the *annual* variations conformably to theory.

These propositions are developed in a special memoir of the author, entitled, *On the diurnal and annual variations of temperature*, and *in particular, the terrestrial temperature at different depths.* This memoir is inserted in the 10th vol. of the *Memoirs of the Brussels Academy of Science.*

Idem, No. 240.

Variations of Temperature in the Lower Strata of the Atmosphere, at different hours of the day. By M. Marcet.

The experiments were made in 1837, and in the first months of 1838, as follows:

A mast was raised 114 feet high, in the middle of a meadow, at a distance from any habitation. Horizontal pieces were attached to it at every 10 feet from each other, to which thermometers were attached, so that they could be raised and lowered by means of pullies. Their balls were covered with a non-conducting substance, to be certain that their temperature would not vary during the interval of their descent. The results of the observations were:

1. An increase of temperature according to the height, at the period of sunset, is a constant phenomenon, whatever the state of the air, except in the case of violent winds. It had before been supposed that this was the case only under a serene sky.

2. This increase is at its *maximum* at sunset, and at its minimum at sunrise; the difference diminishing as the dew becomes more abundant.

3. The limit in height, beyond which the increase is no longer perceived, does not exceed 100 feet when the sky is clear, and is much less in cloudy weather, especially in winter.

4. The increase of temperature, and the limit of its elevation, vary according to the seasons; the *maximum* being in winter, when the ground is covered with snow.

On the 20th January, 1838, a thermometer placed 2 feet above the ground, stood at 16°.25, and another at the height of 52 feet, was at 8.°25, difference 8°. The mean difference deduced from 12 observations made in very cold weather, of thermometers separated by an interval of 50 feet in height, was 5°.5. A comparison of the temperatures of two strata at 2 feet and 5 feet from the ground, gave a still more remarkable result; the mean of 9 observations was 2°.4 during a period of snow.

These facts explain the observation of some gardeners during the last winter, that trees were frozen near the ground, while the upper branches remained intact.

Idem, No. 243.

Progress of Civil Engineering.

On the Width of Tracks for Railroads. By W. R. Casey, *Civil Engineer.*

Whatever may have been the reasons which led to the adoption of the present width of tracks on the Liverpool and Manchester Railway, it will be readily admitted, that no change can *now* be judicious unless it offer advantages not possessed by, or obviate difficulties inseparable from, the usual gauge of 4 ft. 8½ in. between the rails. The deviations from this width as yet made in the United States, few as they are in number and insignificant in amount, leave us absolutely without any facts by which to show the propriety, far less the necessity, of an increased width of track, in a manner entitled to the confidence of an intelligent Board of Directors. All we can do, then, is to examine the grounds on which the only deviations worthy of notice have been recommended, and wholly, or in part, carried into execution.

These are the Russian Railway, with a track 6 feet wide, constructed by the Chev. de Gerstner, and the Great Western Railway, with a track 7 feet wide, by Mr. Brunel. Unfortunately, no reports of the working of the former have been received in this country, though M. de Gerstner, when here, was decidedly opposed to any increase beyond 6 feet, and on the other hand, Mr. Brunel's confidence in the ultimate and triumphant success of his 7 ft. track remains to this day unshaken.

Mr. Brunel had two objects in view in adopting the seven feet gauge:—the attainment of an average speed of from 35 to 40 miles per hour, and a reduction of the friction of the axles by increasing the diameter of the wheels of the cars—indeed an increased diameter of wheel may be said to be the aim of this very important change, for, by this means is obtained the increase in speed as well as the diminution in friction.

There are, probably, few roads in England on which an average speed of 25 miles per hour, and still fewer in the United States, on which an average of 20 miles per hour, is regularly maintained. The rate of traveling on some of the most important thoroughfares in the Union, such as the Utica and Schenectady Railroad, scarcely reaches 15 miles per hour, though their engines could easily maintain a rate of at least 20 miles per hour; and the engines on good roads, such as the Providence, Stonington, and the numerous substantial roads leading from Boston, could without difficulty, perform 25 miles per hour, or more if required. The speed cannot therefore be said to be limited to its present rate by the narrow gauge, but must be attributed to other causes very well known, some of which are pointed out by Mr. Wood; such as the trifling loads, and the immense consumption, of fuel at great velocities. The repairs of road, engines and carriages, offer, however, still greater objections, for they increase in a much greater ratio than the speed, and in fact limit the velocity, on cheap roads, to 15, and on the best roads in the Union, to 20 miles per hour.

The maximum grade on the Great Western Railroad is 4 feet per mile, on which inclination, the friction of the axles will, as Mr. Brunel says, form 80 per ct. of the resistance, and by increasing the diameter of the wheels from 3 to 4 feet, the friction of the axles will be reduced from 80 to 60 per ct. or inversely as the diameter. (Mr. Brunel appears to have overlooked Mr. Hawkshow's error in stating, that an increase of diameter in the wheel with a corresponding increase in the axle would not diminish the friction—in other words, that the friction is as the area of rubbing surface instead of as the weight.)

There are few, if any, roads of importance in the Union, where the inclinations are not, at least, equal to the angle of repose, and even in this extremely favourable case, an increase in diameter of wheel from 3 to 4 feet would only reduce the friction 20 per ct., supposing the road to be straight, but with inclinations of from 30 to 40 ft. per mile and curves of 1,000 or 2,000 feet radius, the advantages of large wheels would be imperceptible in practice—the disadvantages obvious.

Increased steadiness was one of the collateral advantages confidently anticipated from the wide track. Mr. Wood's experiments cannot be considered as indicating any superiority in this respect, but Mr. Brunel states positively, that the notoriously worst part of the road gave the most favourable results in the diagrams, and it is indeed very easy to believe that this apparatus for measuring the irregularities of a machine much simpler than itself, and far better understood, would not give any results on which much reliance would be placed by practical men. If the steadiness actually increased with the width, the improvement from an increase of nearly one half should be immediately and plainly perceptible to all, but if it can only be ascertained by a sensitive apparatus contrived for the purpose, this "collateral advantage" disappears in practice. It is remarkable that Mr. Brunel no where states, that the motion on his road is decidedly easier, more agreeable, or more uniform, than on the narrow track.

The want of room for the most efficient arrangement of the working parts of the engine was, some years since, of itself considered sufficiently important to warrant an increase in width of track. Now, however, little or no difficulty is experienced in the construction of the largest engines, and the most experienced builders in England, as well as the United States, consider any increase beyond a very few inches absolutely injurious with the present construction of engines.

The propriety and practicability of maintaining an average velocity of 40 miles per hour and the great benefits to be derived from 4 feet gradients are so strongly urged by Mr. Brunel, that, with every respect for his talents, it is difficult to believe that he has any practical acquaintance with the repairs and renewals of engines and cars, adjustment of rail, average size of trains and numerous other practical details, experience in which, in this country, goes far to demonstrate that his views cannot be carried out, here at least, requiring as they do, in the first place, an immense outlay to obtain 4 feet gradients and curves of several miles radius, and secondly, an amount of repairs and renewals vastly beyond what is already found so burdensome with only half the proposed velocity, and with less than one-fourth of the probable cost.

In justice to Mr. Brunel it should be borne in mind, that he does not consider the wide gauge advantageous for roads materially differing from his in curves and grades, and his entire course of reasoning would lead to the conclusion, that the ordinary width of tracks was too great for roads with grades of 30 feet per mile and curves of 2,000 radius. He also refers to the Irish Commissioners, who, with certain curves and inclinations, established 6 feet and 2 inches as the most advantageous width, and feels sure that, with a line as favourable as the Great Western, the same principles would have induced them to recommend a gauge of seven feet. The idea that for every series of grades and curves a different width of track should be adopted may be very true in the abstract, and may afford infinite amusement to Dr. Lardner, Irish Commissioners, cis—as well as trans—atlantic "et id genus omne," but it has no attractions for those whose deliberate opinions, instead of being confined to paper, are carried out in practice, and in the success of which, they, as well as the stockholders have a vital interest and the community a stake of some importance. Thus if we admit, that 7 feet is the proper width for the Great Western Railway with grades of 4 feet per mile, and that 4 ft. 8½in. is the proper gauge for the London and Birmingham Railway with grades four times as great, or 16 feet per mile, some of the most important roads in this country would be reduced to a width of little more than 3 feet! It is worthy of remark that instead of pointing out the manner in which the present gauge acts injuriously, and stating some tolerable approximation to the extent of increase by which these difficulties would be surmounted—(an investigation requiring much labor and skill), it is assumed as self-evident, that a wider track must work better than one of the ordinary dimensions, though, for anything deduced from experience in the United States, the most advantageous width is as likely to be found below, as above, 4 ft. 8½ in.

A velocity of 40 miles per hour is not to be thought of, on the railways of the United States; the diminution in friction by increasing the diameter of the wheels will only be felt on a level where it is not of the slightest consequence; there appears to be at least no gain in steadiness, and "gentlemen's carriages" can be carried over the wheels as well as between them.

The success of the new system cannot be considered certain even with the incomparable grades of the Great Western Railway, and it is not easy to say what will justify its introduction on roads with grades of from 18 to 30 and even 40 ft. per mile and curves of 1,000 to 1,500 feet radius, unless we rely entirely on improvements to be hereafter made in the construction of roads and machinery, or anticipate the eventual adoption of a superstructure far more substantial than any now existing; in short a railway of greater capacity than the London and Birmingham, the present business of which may be considered fully equal to what can ever be expected on any railroad in any part of the Union.

But, without reference to any thing which has been said or done in England, how stands the case in the United States? The present width is sufficient for any engines required in practice, and indeed for much heavier ones than any road in this country is able to bear, the wagons are large enough for greater burthens than the wheels and springs ought to be loaded with, and the velocity is limited to its present rate by conditions on which an increased width of track can have at least no beneficial influence. A wider gauge must be attended with increased cost of construction, and if the present superstructure and weight of engines be retained, the same load will be carried at a slight increase of cost on account of the additional capital invested in the width of road, cars, and engines, supposing the cost of repairs and renewals to remain the same as with the present dimensions—a supposition only too favorable to the increased gauge. A greater width of track, with corresponding additional strength in the superstructure and cars, and power in the engines, would undoubtedly enable us to carry at a lower rate than with the present roads, engines, ect.,—if the business could not be properly accommodated by a road of the ordinary dimensions. Before determining therefore on any *material* deviations from the present gauge (which no one supposes to be precisely the very best possible) it should be ascertained that an amount of business might reasonably be expected, which could not be *advantageously* done on a road of the ordinary width.

This subject has been before the Engineering world in this country for at least five years, during which time many of the best roads have been executed, and the very best ones projected and planned. Yet Messrs. McNeill, Whistler & Robinson have retained the 4 ft. 8½in. gauge on all their works, some of which are not yet completed, though they have had in numerous instances, if not in all, a "carte blanche," and were indeed bound by every consideration to have adopted a wider track if it would, in their opinion, have conduced to the efficiency of the road or the interests of the stockholders. In England, the London and Birmingham Railway, the most stupendous work of Internal Improvement on record, has a track of the ordinary width though leading from the heart of the kingdom to the commercial metropolis of the world, and built by one of the first engineers of the age, who could have introduced any alteration he might have deemed judicious.

The practice of all the best engineers of England and the United States, and the fact that the present dimensions have worked admirably well, must be considered almost conclusive evidence, that there are no *engineering* considerations, which urge the adoption of a wider gauge. Still, another width of track *may* be attended with peculiar advantage, and the success, and almost universal adoption, of the ordinary gauge should not deter us from the cool and impartial examination of a greater width, though it should certainly act as a warning from useless innovations and uncalled-for changes.

Since the above was in type, the writer has had the pleasure of reading the admirable report of Messrs. Knight and Latrobe, on the "principal Railways of the Western and Middle States," and notwithstanding their observations and remarks are confined principally to the proper dimensions of the various parts of the superstructure, repairs of engines, and the general economy of railroads, there is not an expression in the remotest degree alluding to the width of tracks, though the subjects discussed are precisely those on which an increased gauge is to exert so beneficial an influence, whilst the high standing of the authors forbids the idea of their neglecting any consideration so important as the width of track, if they consider any change desirable, or if they had even anything useful, or interesting, to offer on the subject. Am. R. R. Jour.

On the Teeth of Wheels. By Robert Willis, *Jacksonian Professor of Natural Philosophy in the University of Cambridge.*

The geometry of the subject of the teeth of wheels may be considered as complete, but it appears that important additions may be made to its practical applications. The general problem is, having given a tooth of any form to determine one which shall work correctly with it. The method of effecting this may be shewn in a simple practical manner. The curve to be traced out which is the shape of the required tooth, is the locus of the intersections of all the outlines of the tooth in every one of its positions. The motion produced by the mere contact of the curve so traced out with the given tooth will be uniform. This then is a practical mode of shewing the practicability of the problem.

The epicycloids and involutes have hitherto, from the facility with which they can be described, been almost universally employed, and practice has been confined to the class of epicycloids which work correctly with straight lines or circles. The defect under which such wheels labour is, that a wheel of fifty teeth of the same pitch will not work correctly with a wheel of one hundred teeth of the same pitch; since the diameter of the describing circle by which the epicycloid is formed, must be made equal to the radius of the pitch circle of the wheel with which the teeth are to work, and will therefore be twice as large in the second case as in the first. Also, if the teeth be epicycloids, generated by a circle whose radius is equal to that of the wheel with which it is to work, which is equally correct, the same remark applies.

This defect was of no great consequence when the teeth were wooden, but it is of great consequence in iron wheels, since the founder must have a new pattern of a wheel of forty teeth for every combination that it may be required to make of this wheel with others. It is desirable that the teeth of wheels be formed so that any tooth may work correctly with any other of the same pitch. This is the case with involute teeth, but the obliquity of the action is an objection to their introduction. The requisite property may be given to epicycloidal teeth, by employing the following proposition. If there be two pitch circles touching each other, an epicycloidal tooth formed by causing a given describing circle to roll on the exterior circumference of the first, will work correctly with an interior epicycloid formed by causing the same describing circle to roll on the interior circumference of the second.

From this Professor Willis deduces the corollary, that if for a set of wheels of the same pitch a constant describing circle be taken and employed to trace those portions of the teeth which project beyond each pitch line by rolling on the exterior circumference, and those which lie within it by rolling on its interior circumference, then any two wheels of the set will work correctly together.* This corollary is new, and constitutes the basis of the system already alluded to.

It only remains to settle the diameter of this constant describing circle. The simplest considerations serve to shew that the diameter of the constant describing circle must not be greater than the radius of the pitch circle; hence, as a convenient rule, make its diameter equal to the radius of the least pitch circle of the set. This rule is perfectly general, applying to racks and large wheels, as well as to annular or internal wheels. The simplicity of this above the old system is obvious, for on the old every epicycloid requires two circular templets; also there must be as many templets as pitch circles in the set, whereas on this system but one describing templet is required.

For machinery in which the wheels move constantly in the same direction, the strength of the teeth may be nearly doubled for the same quantity of materials, by disposing it so that the backs are an involute or the arc of a circle, the acting faces being of the usual form.

In the preceding the exact forms have been described; the author then proceeds to ascertain forms sufficiently accurate for practice, and which are arcs of circles. Euler suggested the substitution of arcs of circles of curvature instead of the curves themselves. The portion of a curve employed in practice is so small that a circular arc is sufficiently accurate, provided the centre and radius with which it is struck be determined by some more accurate method than by mere trial. With this view Professor Willis was led to investigate a method in which the nature and properties of curves proper for teeth are entirely neglected, and a simple construction shewn by which a pair of centres may be at once assigned for a given pair of wheels, whence arcs may be struck that will answer the purpose of enabling these wheels to work correctly together.

The nature of the motion produced by the pressure of one circular arc against another is then examined and reduced to that of a system of three rods, the middle one of which is jointed to two others, movable at their other extremity about a fixed centre; and a simple construction is arrived at by which we may always find a pair of centres for which two circular arcs may be struck through any point, which will drive each other truly for a small distance on each side of that point. This point, when the side of a tooth consists only of a single arc, should be on the line of centres. It is however more advantageous that the tooth should consist of two arcs, for then there will be two points at which the action is exact—one a little before reaching the line of centres, the other a little after passing it.

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* For there is both before and after passing the line of centres an exterior epicycloid working with an interior epicycloid; for before passing the line of centres, the part of the driving tooth *within* the pitch line works only with the portion *without* the pitch line of its follower; and after passing the pitch line the part of the driving tooth *without* the pitch line works with some portion of the follow tooth which is *within* the pitch line.

From these investigations the author was led to construct an instrument for setting out the teeth of wheels, which may be used with perfect facility by the workmen, and which has been termed an Odontograph; the application of which is fully described. The paper contains many practical observations connected with this subject, tables, &c., and concludes with some directions for ascertaining the correct form of cutters. Proc. Inst. Civ. Eng.

The Canal Lifts on the Grand Western Canal. By James Green, M. Inst. C. E.

The Lift which is the subject of the following paper was erected by Mr. Green in the year 1835, on the Grand Western Canal, and has been in operation ever since. Lifts are not intended to supersede the use of canals in all cases, but in those in which a considerable ascent is to be overcome in a short distance, and in which the water is inadequate to the consumption of a common lock, or in which the funds are inadequate to the execution of the work on a scale adapted to such locks.

This Lift is 46 feet in height, and consists of two chambers, similar to those of a common lock, with a pier of masonry between them; each chamber being of sufficient dimensions to admit of a wooden cradle, in which the boat to ascend or descend floats. The cradle being on a level with the pond of the canal, a water-tight gate at the end of the cradle and of the pond of the canal is raised up, and leaves the communication betwixt the water in the canal and in the cradle free, and the boat swims into or out of the cradle.

The cradles are balanced over three cast-iron wheels of 16 feet in diameter, to the centre of one of which is fitted spur and bevel gear, so that the motion may be given by machinery worked by the hand, without any preponderating weight of water in the cradle, when scarcity of water renders this necessary. To this hand gear is also attached break wheels and a break lever for regulating the motion. For the details of the construction of this machinery, and of the manner in which the Lifts are worked, reference must be had to the drawings.

It is obvious that the weights of the additional length of the suspending chains on the side of the cradle which is the lowest must be counterbalanced; for this purpose there is attached to the under side of each cradle a chain of equal weight per foot with the suspending chain, and this elongates under the ascending, and is shortened under the descending, cradle; thus the disparity in the weights due to the suspending chain is obviated.

It is so arranged that the water in the upper cradle is about two inches below the level of the water in the pond; the consequence of which is, that the upper cradle has a slight preponderance first, sufficient to set the machinery in motion; the weight of this water is generally about one ton; it may however be regulated at pleasure.

The strength of materials is the great desideratum in machinery of this nature, and though the Lift here described is but 46 feet, and the boats about 8 tons, the same method is applicable to much greater heights and larger tonnage. The advantages of these Lifts over common locks are great economy of construction, and great saving of time and water.

The time occupied in passing one boat up and another down this Lift of 46 feet is three minutes, whereas thirty minutes would be required to attain the rise of 46 feet by locks; thus the saving in time amounts to $\frac{9}{10}$ths for boats of eight tons.

The quantity of water consumed is about two tons, for eight tons of cargo, whereas in common locks it is about three tons of water per ton of cargo; the saving is therefore 22 parts out of 24, or very nearly 92 per cent. If the trade were all downward, there would, by the use of these Lifts, be carried from the lowest to the highest level of the canal a quantity of water equal to the loads passed down.

Mr. Green stated, in reply to several questions, that in some parts of the canal it had been found impracticable to get a sufficient drain to empty the chamber—they were compelled therefore to use a half lock of 18 inches' fall; that there were seven lifts and one inclined plane on the canal, effecting a rise of 262 feet in eleven miles. That he should not recommend them as applicable to boats of more than 20 or 30 tons. The width of larger boats was an obstacle. They were extremely advantageous for narrow canals; for boats of 50 or 60 feet in length and about 30 tons.

Mr. Parkes remarked, that he considered the question of narrow canals as a most important one—the advantage to be derived from narrow canals was a subject to which sufficient attention had not been paid.

The President called attention to the remark in Mr. Green's paper respecting the quantity of water carried up from one level to another in a downward trade wherever these Lifts are used; then a coal country on high level may supply itself with as much water as it sends down coal. The subject of inclined planes being alluded to, especially those of the Morristown Canal of 200 feet each, where a rise of 1600 feet is effected by eight inclined planes, Mr. G. remarked that more water and time must be expended, the friction and length being much greater. In the Lifts there was only as much water consumed as was equal to the load, but that he should not consider them as practically applicable to more than 60 or 70 feet. Favourable levels with ascents of more than 60 or 70 feet could seldom be found; could he have had the choice of the line in this particular instance, he should have effected by four lifts the rise for which seven are now employed. Ibid.

On the Ventilation of Tunnels. *By* W. West.

This paper contains an account of some experiments on the temperature of the air in a tunnel on the Leeds and Selby Railway. There are three shafts in the tunnel; and he observes, the temperature of the external air being 34°, the temperature at the mouth and as far as the first shaft was 34½°, but that immediately beyond this shaft it rose to 35°, and increased uniformly up to the farther end, at which point it was 57°. From this fact the author infers that the air passed up the shaft, and that the tunnel would be more completely ventilated without any shafts; and that shafts generally are an impediment to perfect ventilation. Ibid.

"*On the relative Heating Powers of Coke and Coal in Melting Glass.*" *By* Apsley Pellatt, Assoc. Inst. C. E.

The object of this paper is to confirm some statements of Mr. Parkes as to the calorific power of coke and coal from experience of the authors in melting glass. The great loss of heat arising from the flame and unconsumed gaseous portions of the fuel being driven up the flues, when the furnaces are heated by coal, and the fact that coke succeeds better than coal in annealing glass, determined the author to persevere for a month in heating the furnaces with coke, and to compare the result with those obtained when the best coal was employed.

The construction of the furnace and the arrangement of the pots and flues are described. The furnace is somewhat reverberatory, being between an air furnace and an oven; the smoke and flame not escaping at the top, but being drawn to flues betwixt the pots, which are set round in a circle. For the purpose of obtaining sufficient heat about the points and sides of the pots, there are small holes, called "bye-holes," through which the flames should play outward in a length of 5 or 8 inches. The healthful action of the furnace is indicated by the length of the flame issuing from the bye-holes and tops of the flues. Great care is requisite in regulating the supply of air, too much air endangering the pots, too little checking the heat of the furnace. The bars were obliged to be placed at 2 inches apart instead of 1½; the greater concentrated heat of the coke not only requiring more air, but having a tendency to melt the bars; lumps of fire-brick also were thrown in to supply the deficiency of clinkers. To make, however, the flues and bye-holes draw well, it is necessary to use ⅕th of screened coals with ⅘ths of good coke, by measure. The following is the result:—For nine months the consumption of coals for a 7 pot furnace was 18 tons per week. For four months, on the new system, the consumption was 10½ tons of coke, and 5 tons of screened coal per week. Deducting then these 5 tons, it appears that 10½ tons of coke are of the same value as 13 tons of coal, or there is a saving of near 20 per cent. in the weight of fuel, and a superiority of 25 per cent. in the heating power of the coke above that of coal. Considerable advantage is also derived from the saving of the pots and in other incidents peculiar to the manufacture of glass.

Mr. Parkes observed that the preceding statements had more than confirmed his results. From the statements of Mr. Pambour, on whose data his calculations had been founded, it appeared that gas coke was inferior to Worsley coke by 12½ per cent.; in his reasonings he had allowed 20 per cent. as the difference betwixt good coke and coal; but according to the results given by Mr. Pellatt, that allowance ought to be 32½ per cent. He was of opinion that the advantage to be ascribed to the screenings was part chemical and part mechanical. The coal would fill up the interstices of the coke, and prevent the air from escaping unconsumed.

Mr. Pellatt remarked, that the safety of the pots was a very important consideration. By the terms hard and soft coke, he understood foundry and gas coke; the former gave a much more intense heat, and lasted longer. The coke he had used was gas coke, and about 14 cwt. to the chaldron. Mr. Fox stated that the coke in use on the London and Birmingham Railway is about the same weight. It was stated that coal which lost ¼th in weight gained ¼th in bulk by coking. Ibid.

Obituary Notice of M. Malinvaud, Engineer in the Royal Mining Corps. *By* M. F. Le Play, *Mining Engineer.*

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

More than eighteen months have elapsed since the Corps of Mines lost in M. Malinvaud one of its youngest members, and one of the most devoted to his country's good; in calling to mind, at the present time, the particulars of his life, we are sure of exciting a profound sympathy in the breasts of all who knew him. We feel more forcibly, every day, that the memory of so noble a spirit ought to be religiously preserved; and the serious duty which we have just accomplished in interrogating the recollections of his friends, will have furnished us, if need be, with the proof of this assertion.

Jean-Firmin Malinvaud, was born at Limoges, on the 8th of September, 1807, and early distinguished himself by a rapid progress in his studies in the Royal College of that city. His professors having observed in him a peculiar aptitude for the mathematical sciences, encouraged him to offer himself for admission to the Polytechnic School. He entered it in 1826, after a single examination, and in the same year, in fact, in which he had attended the course of philosophy in the College. This admission, was, however, rather premature. Classed, on his entrance, in advance of his promotion, he soon discovered with pain, that he could not successfully follow the prescribed course. A fruitless effort of three months almost discouraged him, and his career would thus have been arrested at its commencement, if he had not summoned to his aid, and given an early demonstration of, that ardour in study, and that power over his own will, which distinguished him through life. Seconded by the admirable organization of classes, which is the principal secret and the most powerful means of polytechnic education, he applied himself incessantly in obtaining from his comrades that instruction which the lessons of the teachers could not yet supply him; but in a short time these lessons were no longer difficult or obscure; he gradually became qualified to render to other students, less happily organized than himself, the same assistance which had given a spring to his own faculties. At the opening of the second year of his studies, he was promoted to the grade of sergeant or chief of his room; and was finally classed in the fifth rank at the closing examination.

This success allowed him to pursue the vocation which his station in the polytechnic school had revealed to him, and three years later, he came from the school of mines the first on the list of those who had entered it with him.

The scientific journies which he took in 1830 and 31, first with M. Baudin, and afterwards with M. M. Baudin and Harlé, completed his theoretic knowledge, and initiated him in the practice of his art. His observations in the course of these two journies, furnished two excellent journals of travel, and four memoirs, which were the prelude of his more important labours as an engineer.

One of these memoirs drew the attention of the committee on the Annales des Mines, and was published in that collection in 1833, under the title of "*Memoirs on the position, exploration, and treatment of the iron ores in the Valley de l'Aubois*" (*Cher.*) Very different opinions existed at that time among geologists with respect to the epoch of the formation of that prodigious formation of iron in granular, fragmentary, and nodular masses, generally known under the improper appellation of alluvial ore, which exists in a notable portion in the soil of France, and which supplies the greater number of our air furnaces.

It was a disputed question whether these ores all belonged to the same or to different formations; and the partizans of the first hypothesis were no less divided with respect to the period which should be assigned to these deposits, since their suppositions referred to the whole series of strata comprised between the diluvial formation and the upper portion of the Jurassique. In his memoir on the Valley of Aubois, Malinvaud discussed all these opinions with that soundness of judgment for which he was distinguished, and which is more indispensable perhaps in geology than in any other branch of natural science. This memoir contributed not a little to settle the opinion now generally entertained, that there does exist, indeed, ores called *alluvion* in all the strata comprehended between modern alluvions and jurassique formations, but that the ores of the Valley of Aubois, and in general, of Nivernais and Berry, as well as a great part of the iron ores of our other provinces, belong to the middle stage of tertiary formations.

Having become a sub-engineer, Malinvaud was charged, at the close of 1832, with the ordinary service of the Loire. But at the time even of his arrival at Saint Etienne, his health had become seriously affected; an attack of cholera had left a chronic inflammation of the stomach, which had been aggravated by the loss, which he most sensibly felt, of a beloved mother. Nevertheless, the duties of his new station, to which he devoted himself with that ardent zeal which animated him in all his labours, produced at first a beneficial diversion from his sufferings.

The eminent qualities of the new engineer of the district of Saint Etienne, were soon appreciated by the overseers of that rich basin, when an unforeseen circumstance brought them more distinctly into view. The chief engineer of the department, M. Delsériès, having been obliged temporarily to leave la Loire, the service of the department was confided, par interim, to his young substitute. Without being dismayed by this heavy task, the latter applied himself to its fulfilment in such a manner as to conciliate the esteem of the overseers. He succeeded in maintaining with them the friendly relations favourable to the progress of the service, without departing from that conscientious firmness of principle, which was one of the prominent traits of his character.

He exhibited this firmness, still more rare than science and talent, when he had to claim the intervention of the judicial authority to put an end to two illegal enterprizes, by which the safety of several of the inhabitants of the town of Saint Chamond would have been put to hazard.

At Rive-de-Gier, the vicinity of a great body of subterranean water, rendered a certain mining operation, which the proprietors were not in a hurry to abandon, very dangerous. Malinvaud pointed out the extent of the danger, and induced the prefect to signify to the lease holders that they must close their mine. At the moment when this notification was going into effect, the frail obstacles which had hitherto protected the labourers, yielded suddenly to the pressure of the water, without producing however, any serious accident; and our associate had thus the satisfaction to prevent one of those catastrophies unhappily so frequent in subterranean labours.

This late accident which the young aspirant had so skilfully foreseen, was but one of numerous such cases to which the district of Rive-de-Gier was subjected. In this coal basin, one of the richest of continental Europe, some of the pits, previously very prosperous, were every year submerged by the subterranean waters; and the greater number of those that remained were threatened with complete invasion. Justly alarmed at a state of things, resulting solely from the negligence and dissension of the overseers, the administration which had not yet availed themselves of the law of 27th April, 1838, wished to ascertain fully the cause and progress of the evil, and to find the proper remedy. In order to throw light upon this question, which might be considered as a vital one to the manufacturing region of central France, the director general of roads and bridges appointed a committee, consisting of M. M. Delsériès, Combes, Clapeyron, Malinvaud and Sénarmont. Malinvaud took an active part in the interesting and important labours of this committee.

At the same period, a deplorable occurrence opened to him a new career. Our unfortunate comrade, Jabin, was killed in a shaft of the mine *Bérard*, and his death left vacant the chair of chemistry and metallurgy in the mining school of Saint Etienne. Malinvaud was appointed his successor. What a sad and striking resemblance! Jabin, only 31 years of age, was removed from a service which he loved by an event as grievous as unexpected; and four years afterwards a similar catastrophe gave a death blow to his successor in the chair, which they had both so worthily occupied.

Malinvaud had a particular predilection for chemistry, and the possibility of realizing some important experiments which he had in his mind, enhanced in his estimation the value of his appointment. He received at the same time the news of his promotion to the rank of engineer. His health seemed to be confirmed; and three months afterwards, he married at Lyons, Miss Camilla Kerris, sister of the engineer of that name, attached to the corps of naval construction. His admission into this excellent family, realized his fondest wishes. The eminent moral qualities with which he was endowed, and those of his companion, enabled him to enjoy in this union that domestic happiness which was to him the greatest of all blessings.

An important mission having been entrusted to the professor of the geological course, Malinvaud undertook to perform the greater portion of it, and during the whole of the Scholastic year 1833–34, he acquitted himself of his double duty in a distinguished manner; and all who witnessed his professional career, admired the method, the clearness and the precision of his instructions. A chastened ardour, a constant solicitude induced him to regard his avocations not only as a duty, but as a high calling. The time not occupied in his chair or in the operations of the laboratory, was devoted to the completion, by means of private instruction, of his public teaching, at the expense of his repose. He gathered, at least, that sweet reward which he was ambitious to acquire. The respect and affection of his pupils, at first surprised at his rigidity, were secured; their remarkable progress determined at the general examinations, in presence of M. Beaunier, inspector general of mines, and then director of the school of mines, enabled him to appreciate the eulogiums of this worthy judge of substantial merit.

In devoting himself to his professional duties, Malinvaud had undertaken to make comparative trials of the properties of the coal extracted from the principal coal basins of France; he had constructed a gasometer, in order that the results, obtained on a large scale, might be immediately applicable to the arts. But he was unable to reap the fruit of his labours. A devotion to his laboratory too long protracted, and above all, the fatigues of his professorship, had again deeply affected his health; an irritation of the larynx became manifest; but Malinvaud, at first, paid but little attention to it, and continued with no less industry, his chemical course during the second year. But the disease became so serious, that in March, 1835, he was obliged to relinquish his functions as professor. The activity of his disposition did not, however, allow him to give up to repose, whatever need he had of it. He wished only for a change of occupation, and the director general acceded to this desire, and assigned to him the service of the district of Chalons-Sur-Saone.

An abode in a milder climate than that of La Loire, and the interest which his mineralogical district, with its manufacturing industry afforded him, reacted at first favourably on his health; a temporary amelioration took place in October, 1835; but unhappily consulting nothing but his zeal for active labour, he exposed himself to imprudent fatigue, and in the intervals of long and frequent excursions among the mines, he received with eager complaisance the overseers who were not tardy in estimating the high capacity and the utility of his counsels, which he lavished with a devotedness for which they cherish a grateful recollection. He did not perceive that this new kind of professorship was bringing upon him a renewal of his fatal disease.

An accident altogether unforeseen, hastened its return, and impressed upon it a character much more serious.

In July, 1836, Malinvaud visited the mines of Epinac. Desirous of ascertaining the exact condition of the *Curier* pit, he wished to make a descent by one of the buckets, instead of going down the ladder, as is usually practised in that mine. Unhappily the lower-bucket, whose motion is the reverse of that which descends from the opening of the pit, had not been unhooked, so that in the middle of the pit, 300 feet from the bottom, it caught that which contained Malinvaud and the director of the mine. The workman, in his confusion, not having stopped the motion of the machine, the descending bucket, still hanging to the other, was overturned so as to become horizontal. Our unfortunate associate was thus completely overturned; his head was caught between the bucket and the walls of the pit, his mouth was cut, the hook of his mining lamp pierced his under lip and broke a tooth. A moment after, the two buckets separated, but so suddenly, that the rope, if it had not been new, would infallibly have been broken. The bucket, impelled by this shock, swung many times against the wall, and in these rapid movements, Malinvaud had his left hand wounded and his right side greatly bruised.

From that time he did not recover even the appearance of health, and could not fail to become aware of his situation. This conviction is discoverable in the following lines addressed to the director general, who had kindly asked of him an account of the injury he had received.

"Such are, Mr. Director General, the details of this accident: it has produced a reaction very unfavourable to the disease with which I was affected; for since that time I have begun to spit blood in greater quantity than before."

He wrote these lines in the early part of 1837, on his return from a journey to Creuzot, made in December and January. He had not till then decided on quitting the service to which he had formed so strong an attachment.

To this, however, he was compelled; but scarcely was he established in Paris before all prospect of a cure of his malady was given up. He at first concealed this painful conviction for fear of afflicting his family and friends. He continued to receive visits from numbers of the overseers of Saone-et-Loire; he loved to confer with them on their operations, and to give them advice. We have witnessed the eagerness with which his counsels were sought after, and the affectionate interest manifested by the overseers, who were permitted to see him in these, his declining hours.

It was at length necessary to declare to his afflicted family that all restoration appeared impossible: supported by a piety worthy of his character, he resigned himself with calmness to this precocious reversal of his happiness, and the loss of that future worldly happiness which had appeared so beautiful in prospect. The most trying part of this sacrifice was the renouncement of the delightful task of educating by his own paternal care two twin daughters, still in their infancy. Preserving to the last moment the exquisite sensibilities of his heart, he exhorted, in the midst of severe suffering, his beloved wife, and his adopted mother, to a resignation to their allotment. For a long time he wished to conceal from his father and brother, who were at a distance, the danger of his situation; but obliged at length to undeceive them, he devoted the remainder of his strength in writing to them in the most touching strains of a final separation.

It was chiefly in the last period of his life that we were able to appreciate the extent of the loss which awaited us. The talents for which Malinvaud was more eminently distinguished, was a quick penetration, and great rectitude of judgment, seconded by a memory so powerful, that all those who, with ourselves, shared in his studies, had to acknowledge that they had never met with one so remarkable. He brought to the performance of his engineering duties a rigidity of principle, which rendered still more severe the sentiment of honour instilled by a polytechnic education. A mildness and a kindness which were never mistaken, gave an inexpressible charm to his manifestations of friendship, and all those virtues of the private friend were enhanced by a nobleness of disposition which preserved unspotted, the candour and benignity of his heart.

A life so pure, and so advantageously spent, continued but 29 years! Malinvaud died the 14th of March, 1837, calm, resigned, and in a peaceful sleep, as he had desired. Annales des Mines, tom xiv. liv. vi.

Mechanics' Register.

Screw Propelled Steam Ship.

The steam-ship Archimedes (230 tons N. M.), Minter, arrived here yesterday from London. She is fitted upon a new principle with her machinery, which is the invention of T. Smith, Esq., and manufactured by Messrs. Rennie. The vessel is at present propelled at the rate of ten knots by the log, with a screw working upon an horizontal axle in the after run of her, the screw making 150 revolutions in the minute. The time taken on her trip down here was as follows:—From London to Gravesend one hour and forty minutes, and from Gravesend to the Nore one hour and thirty minutes. The steam can be raised from the time of lighting the fires in thirty-five to forty minutes. The engines are two forty-fives, and for every revolution of the engine the screw makes five and one third turns. The machinery is placed nearly down upon the keelson, and admirably protected on each side the vessel by coal boxes eight feet through, being a grand consideration for vessels of war fitted on the above principle. She is intended to cruise up and down the coast for one week to improve her trim and increase her speed, of which the inventor has not the least doubt. The vessel is beautifully modelled, and were it not for the appearance of her funnel she might be taken for the Phantom Ship gliding quietly over the surface of the deep, scarcely leaving a ripple behind her.

Naut. Mag.

New Apparatus for Stopping Carriages.

Several highly successful and satisfactory experiments have lately been made of a very ingenious invention, having for its object the prevention of accidents from horses taking fright, starting, or running away. The machinery, with but trifling expense, can be applied to carriages, cabs, or any other description of vehicles. Its mode of operation is as follows,—On the nave of the wheel is fixed a small gun metal wheel; in front of the axle runs a steel spindle, with a small cog attached; over the spindle is a cylinder, and to which the pulley or check string is affixed. The moment it is put in action, the spindle advances, and the cog revolves gradually round the gun metal wheel, which is affixed on the nave, carrying with it reins leading from the horse's head, composed of cat-gut, or patent cord, covered with leather. As the wheel revolves, the cylinder, which is about an inch in diameter, is gathering up the reins, until the horses are brought to a stand still; when, by letting loose the check string, the horses immediately have their heads free. The security of the invention may be imagined when it is stated, that a child inside the carriage can with ease, and at pleasure, stop the most spirited and powerful cattle, supposing the reins to be broken, or the coachman's command *over* a vicious or unruly team overcome.

Farm. Mag.

Voyage of the Ship "Ironsides."

This, the first sailing vessel constructed of iron which has ever been dispatched to encounter the risk of a transatlantic voyage, and which left Liverpool some five months since, for the Brazils, entered the Mersey on the 1st of May. The homeward passage from Aricati was accomplished in forty days, which is considered to be no despicable achievement, as during the whole trip light winds prevailed. The return of the "*Ironsides*" has completely established the practicability of navigating the ocean safely and surely in ships constructed of iron; the compass, whose action it was predicted would invariably be deranged, worked correctly; and the superiority of the material of which she is built, is proved by the fact, that from the day on which she sailed for Pernambuco, during the time she remained at the Brazils, and in the course of her voyage home, on no one occasion was it necessary to use the pumps; in fact, her hull is absolutely and literally water tight. This indemnity against leaking is no unimportant advantage, the proof of it, occurring too, as it does, at a time when timber is scarce, and consequently dear. So little has the "*Ironsides*" suffered from exposure to wind and weather, that her external appearance would induce the opinion that she had but lately been launched. Her tonnage is 264 tons; draft of water aft, 8ft. 7 in.; forward 8 ft. 3 in.; her cargo consists of 1,800 bales of cotton.

Mec. Mag.

New Light for Light-houses.

A letter of the 10th of March from Trieste, states that a new system of producing light for light-houses has been invented by a serjeant-major in the Austrian artillery, named Selckonsky. The apparatus consists of a parabolic mirror, 62 inches by 30, with a twelve-inch focus, and the light is produced by a new kind of wax candle, invented by M. Selckonsky. It has been tried under the inspection of the Austrian Lloyd's Company in the port of Trieste, by being erected on the mast of a vessel. The light is said to have illuminated the whole of the port and the surrounding parts of the town equal to the moon at full, and at the distance of six hundred yards the finest writing could be read. A second trial has been made in bad weather, and the result was proportionably favourable. Ibid.

Mechanic's Fair, Boston.

The second exhibition of the Massachusetts Charitable Mechanic Association for the encouragement of Manufactures and the Mechanic Arts, will be opened at Quincy Hall on Monday, the 23rd of September, 1839.

Those intending to offer articles for premium or exhibition, are requested to give early notice to the Secretary, Mr. J. G. Rogers.

All articles intended for exhibition must be delivered to the Superintendent, William Washburn, at Quincy Hall, on, or previous to, Wednesday the 18th of September, accompanied by an invoice, and a particular description of all new and important inventions, or improvements in the articles offered.

Steam power will be provided to put machinery into operation, and premiums will be awarded to the makers of articles deemed most worthy of that distinction by competent judges. Those offered by apprentices, will have a division especially appropriated to them. George Danacott is the President of this Institution.

We had the high gratification of visiting the first exhibition of this Society, which took place at a period of much depression among the manufacturers, and after a very brief notice, but the exhibition itself furnished no evidence that such was the state of affairs. Its success was most perfect, far surpassing the anticipations of its warmest supporters, the spacious apartments which it occupied having been, from first to last, crowded by admiring visitors. There can be no ground for apprehension therefore, that the approaching exhibition will not afford a display of which every American may be proud.

Annual Exhibition of the American Institute, New York.

The twelfth Annual Fair of this Institution will be opened at Niblo's Garden on the 7th of October 1839.

Contributions from exhibitors will be received on the Thursday, Friday, and Saturday, immediately preceding. The Anniversary Address will be delivered by the Hon. Samuel Southard, on the evening of the 10th. The Silk Convention will be held on the evening of the 11th. On the first Thursday of September, there is to be a Ploughing Exhibition at Harlem, at 2 o'clock, P. M., under the auspices of the Institute.

To the spacious accommodations afforded at Niblo's Garden, there have been added for the purpose of this exhibition, two rooms, each measuring 110 by 25 feet. There has also been provided, contiguous to the garden, accommodations for the exhibition of cattle of pure breed, for horses, and for any extraordinary breeds of sheep, swine, &c.

LUNAR OCCULTATIONS FOR PHILADELPHIA, OCTOBER, 1839.					Angles reckoned to the right or westward round the circle, asseen in an inverting telescope. ☞ For directvision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
14	8	46	Im. τ Sagittarii	4	152°	188°
14	9	38	Em.		247	290
17	8	28	Im. δ Capricorni	3.4	175	183
17	9	20	Em.		257	276
28	13	15	Im. γ Cancri	5	109	54
28	14	13	Em.		223	168

Meteorological Observations for April, 1839.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
				Inch's	Inch's			Inches.	
	1	31	58	30.20	30.20	E.	Moderate.		Clear—do.
	2	46	59	29.90	29.95	N E.	Brisk.		Partially cloudy—clear.
	3	41	53	30.10	30.10	E.	Moderate.		Cloudy—do.
	4	50	66	30.10	30.10	E.W.	do.		Partially cloudy—clear.
	5	47	76	30.05	30.05	S.E.	do.		Foggy—clear.
☽	6	47	69	30.15	30.10	S.W.	do.		Clear—clear.
	7	49	74	29.90	29.80	S.W.	do.		Clear—do.
	8	46	59	29.90	29.95	N.	Brisk.		Clear—do.
	9	36	58	30.05	30.05	N.	do.		Clear—do.
	10	38	65	30.10	30.05	S.W.	do.		Cloudy—hazy.
	11	50	76	29.90	29.85	W.	do.		Clear—lightly cloudy.
⊗	12	59	60	29.60	29.41	S.	do.	1.00	Rain—drizzle.
	13	46	44	29.50	29.60	N.E.	do.	.27	Rain—do.
	14	36	47	29.74	29.74	N.W.	do.		Drizzle—cloudy.
	15	40	59	29.75	29.65	W.	do.		Partially cloudy—clear
	16	42	64	29.65	29.60	W.	do.		Clear—do.
	17	43	43	29.25	29.34	S.E.W.	Brisk.		Cloudy—do.
	18	37	49	29.50	29.70	W.	Moderate.		Clear—do.
	19	40	50	29.76	29.80	W.	do.		Clear—do.
☾	20	43	71	29.70	29.65	W.	do.		Clear—do.
	21	36	52	29.95	30.00	E.	do.		Clear—do.
	22	34	64	30.20	30.20	S.	do.		Clear—do.
	23	37	67	30.34	30.34	S.E.	do.		Clear—do.
	24	46	75	30.10	30.05	S.W.	Brisk.		Clear do.—thunder shower,
	25	50	72	29.90	29.86	W.	do.		Clear—do.
	26	47	69	29 86	29.90	W.	Blustering		Clear—do.
	27	50	76	29.85	29.80	W.	Brisk.		Clear—do.
☺	28	52	82	29.70	29.70	W.	do.		Lightly cloudy—do. do.
	29	48	64	29.90	30.00	E.	Moderate.		Cloudy—partially do.
	30	48	62	29.85	29.80	S.E.	do.		Cloudy—do.
	Mean	44.03	62 77	29 83	29.83			1.39	

	Thermometer.	Barometer.
Maximum height during the month.	82. on 28th.	30.34 on 23d.
Minimum " " "	31. 1st.	29.25 17th.
Mean	53.40	29.88

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SEPTEMBER, 1839.

Civil Engineering.

Comparison of the Rail Roads of Belgium with those of the United States.

By the Chevalier de Gerstner.

The rapid increase of Internal Improvements in the United States has excited for several years public attention in Europe, and the friends of those improvements desired very much a detailed report on the extent and progress of those works, and particularly of *Rail Roads.* There is no such report published in the United States, and even those published in England, France, and Germany are very imperfect.

In 1824 I had charge of the first Rail Road on the continent of Europe, to connect the rivers Moldau and Danube in Austria, by a line which is one hundred and thirty miles long, and which has been in operation since 1832. I constructed in 1836 and 1837 the first Rail Road in Russia, from St. Petersburg to Zarskoe-Selo and Pawlowsk, a line of only 17 miles in length, but forming the commencement of a Rail Road of four hundred and twenty miles from St. Petersburg to Moscow. This Rail Road being likewise in full operation, I left Europe last fall and arrived in the Great Western on the 15th of November, 1838, at New York. After a short stay of a few days I went to Albany, and inspected all the Rail Roads between that place and Lake Erie; I then proceeded to the Eastern States and visited all the Rail Roads in Massachusetts, and went via New York, Philadelphia, Baltimore, and Washington, through Virginia, North and South Carolina, Georgia, and Alabama, to New Orleans, always visiting the Rail Road lines in the different States. I went then up the Mississippi and Ohio, and am now about inspecting the Internal Improvements of the Western States, and some of those in Pennsylvania, which I have not yet seen.

I have already passed over more than two thousand miles of Rail Roads, and have every where been received with the greatest kindness; the Presidents, Directors and Engineers of the different Rail Road lines gave me not only all their printed reports, but laid before me, with the greatest liberality, their books and accounts, in order to afford me every kind of information. I fulfil only my duty when I publicly acknowledge, that such a liberality is only to be found amongst a free and enlightened people, where all public works are based on the principle of publicity, and where secrets do not exist. I wish, therefore, to make those gentlemen, to whom I am so much indebted, another communication, which will show at the same time what has been done during the last years in Europe. Having within a few days received the last Reports on the Belgian Rail Roads, I publish in the following abstract the history and progress of those communications in Belgium, together with a comparison of them with the American Rail Roads.

According to the facts collected during my travels since my arrival in New York, there are now *over three thousand miles of Rail Roads completed and in operation in the United States;* four hundred and twenty-five locomotives, of which the greatest number were made in this country, run on the several Rail Roads, and I believe, that up to the end of 1839, the length of Rail Roads in the United States may amount to forty-one hundred miles. The capital expended on the Rail Roads now in operation is about sixty millions of dollars, or at an average cost of twenty thousand dollars per mile, for which sum the Rail Roads, with the buildings, have been constructed, and the necessary locomotives and cars bought.

Several Rail Roads have been undertaken with insufficient means, and the shareholders found themselves under the necessity of employing the income of the first years in improving the Rail Road, in building engine-houses, &c. and purchasing locomotives and cars. In consequence of this the shareholders got during that time no dividends, but the Rail Road still yielded a good income. Other Rail Roads, when finished, paid from five to ten per cent. income to the stockholders; others have not yet paid any dividends for want of a sufficient number of passengers and freight. The *average result* of the Rail Roads now in operation in the United States is, *that they give a yearly interest of five and a half per cent. on the capital invested.* This result must be regarded as very satisfactory, because the greatest part of the lines have only been a few years in operation.

On all lines there is a yearly increase of at least from fifteen to twenty per cent. in the gross income, so that even those lines which do not pay now will give in a few years a handsome dividend. According to these statements, based on the communications collected in this country, I have no doubt, that the large capital invested in Rail Roads, in the United States, will not only produce an incalculable benefit to the country, but likewise pay the shareholders a dividend, which under good management, by the constant progress in population and trade, must likewise from year to year increase.

Good book-keeping and clear accounts are matters of importance in every business; Rail Roads are new constructions, and experience, particularly in working them, is still very much wanted. When the Superintendent of a Rail Road in operation keeps clear and distinct accounts, he will in a few years learn by experience what can be improved, and which items of expenses can be reduced. The following statement contains a manner of making the Rail Road accounts, which, in my opinion, must prove very useful for every Rail Road Company.

I. *History, Length and Cost of Construction of the Belgian Rail Roads.*

The Rail Roads, which up to the present time have been constructed in

England and on the continent of Europe, had no other object than to connect two important places of the country, and in constructing them, therefore, local interest more or less prevailed. That Rail Roads are to be considered *as great thoroughfares*, that they can form in a country the principal lines of internal communication—that, therefore, the means for their establishment should be such, as only can be raised by a whole nation, nobody in Europe would have maintained previous to 1834, and it is even now denied by many individuals of high standing and influence. Belgium, united with Holland since 1815, had distinguished itself in Europe, by its fine roads, and magnificent canals; the latter, being constructed, for the greatest part, in a level country, and without locks were used not only for the transportation of goods, but also for passengers, especially the lower classes, which there, more than in any other country, made use of the canal boats for their travels. It is evident, that no individuals would ever have attempted to construct Rail Roads parallel, and in opposition, to such canals and turnpike roads.

In the year 1830, Belgium declared itself independent of Holland, and elected by the representatives of the nation its own sovereign. King Leopold I. soon discovered, that the country, for its perfect tranquillity, wanted "labour;" a series of wise legislation encouraged the nation to useful and profitable enterprizes, and every person with talent and inclination found employment and earnings in a country, which isolated from all its neighbours, was confined to its own resources. But to gain over public opinion, a great national work was to be accomplished by the new government, which might fill posterity with admiration. The time was past for Egyptian pyramids, for Roman triumphal arches, and French monuments of war. A more useful monument, one of peace and intelligence, was to remind the nation of that eventful period. The King ordered the whole country to be surveyed by able Engineers, the necessary plans and estimates formed, and on the first of May 1834, a law was proclaimed, according to which *a system of Rail Roads was to be introduced through the whole kingdom, and executed at the expense of the State;* on two points (at Antwerp and Ostend), the Rail Roads were to lead to the seaports, on two points to connect with France, and on one point with Prussia (Germany.)

The news of the gigantic work, undertaken by a State, even not yet acknowledged as such by the northern powers, and with only four millions of inhabitants, excited the greatest surprise in Europe, and few only could conceive the great results, which this grand project must necessarily produce *on the independence of the nation and its internal welfare*, its commerce and industry; the former being the principal aim and the promotion of commerce and industry a subordinate one, although the great mass of the people were unable to comprehend the grand idea of the plan.

King Leopold found in his former minister of public works, Mr. De Theux, and in his successor, Mr. Nothomb, vigorous supporters. The Engineers were vieing in the swift prosecution of the work, and, in the course of four years, more has been done than was expected. The enlightened minister Nothomb published annual reports to the Legislative Assembly, besides other special reports of the progress of the works, in which the public in Europe find a rich source of experience, not to be met with in any other report or work on the subject. Europe has to render thanks to the King, who the first realized such a grand idea, and to his enlightened minister, who judiciously conducted the work, and so liberally communicated its results.

The limited space of this report does not allow a detailed extract from the above mentioned reports of the minister Nothomb and the Engineers; I shall therefore only give a brief account containing the results in numbers, and afterwards compare these results with those of Rail Roads in the United States. The following table contains the sections of the Rail Roads which were opened up to the end of 1838, and their lengths in mètres and English miles.

SECTION OF RAIL ROAD.		Time of opening.	LENGTH.	
From	To		In French mètres.	In English miles.
Brussels,	Malines,	5 May 1835,	20,300,	12.6
Malines,	Antwerp,	3 May 1836,	23,500,	14.6
Malines,	Termonde,	2 January 1887,	26,700,	16.5
Malines,	Louvain,	10 September 1837,	23,750,	14.7
Louvain,	Tirlemont,	22 September 1837,	17,750,	11.0
Termonde,	Gent,	28 September 1837,	30,500,	18.9
Tirlemont,	Waremme,	2 April 1838,	27,200,	16.8
Waremme,	Ans,	2 April 1838,	18,900,	11.7
Gent,	Bruges,	12 August 1838,	44,500,	27.6
Bruges,	Ostend,	28 August 1838,	23,500,	14.6
		Total,	256,600	159.0

According to the report, made by the minister to the house of Representatives, on the 26th November 1838, the above ten sections including buildings, locomotives and cars cost thirty-four millions of francs; this gives per mile of Road forty-one thousand three hundred dollars. The Rail Road from Brussels to Antwerp, 27.2 miles, has a double track, the remainder are constructed with only a single track, the rails weighing forty-five pounds per yard. But there are several buildings yet to be erected, and different works on the line to be executed, and besides a number of freight cars to be provided for, &c.; with all this the cost per mile will amount to forty-five thousand dollars.

II. Tariff for Passengers, Speed.

There are on the Belgian Rail Roads four classes of passenger cars, differing only in elegance and comfort, but going in the same train, and therefore with equal velocity. The prices are:

In the Berlines, . .	2⅓ cents per mile,	For each Passenger with 44 lbs. of baggage.
" Diligences, . .	2 " " "	
" Chars à Bancs,	1⅓ " " "	
" Wagons, . .	0.8 " " "	

The trains perform at an average of seventeen English miles per hour, all stoppages included, or from twenty to twenty-five miles while running.

III. Traffic and Revenue on the Belgian Rail Roads.

The Rail Roads in Belgium are frequented by more passengers than any other Rail Roads; the transportation of freight was only begun between Brussels and Antwerp, in 1838. The following table shows the travel since the opening of the first section, until the 31st of October 1838.

Period.	Total number of passengers.	Average distance performed by each passenger	Number of passengers reduced for one mile.	Gross Income.		
				From all passengers		per pas. per mile
		Miles.		Francs.	Dollars.	Am. cts.
From 5th May 1835 to 2d of May 1836	563,201	11.6	6,536,754	359,394	67,429	1.03
From 3d of May to 31st of of Dec. 1836	729,545	20.2	14,718,709	734,736	137,849	0.93
In the year 1837	1,384,577	17.2	23,838,436	1,416,983	265,850	1.11
From 1st of Jan. to 31st of Oct. 1838.	1,921,619	22.8	43,887,864	2,589,384	485,813	1.11
In 3 years 6 months	4,598,942	19.35	88,981,763	5,100,497	956,941	1.07

to which must be added forty-four thousand one hundred and forty-eight francs, or eight thousand two hundred and eighty-one dollars, as the gross income from freight in the year 1838.

In the year 1837, there were among the number of passengers, thirty thousand eight hundred and fifty-seven soldiers, for whom, in consequence of an arrangement with the ministry of the War Department, only half price was paid.

In 1838 the total number of passengers amounted, according to the "Moniteur Belge," to two million two hundred and thirty-eight thousand three hundred and three, comprising fifty-six thousand six hundred and eighteen soldiers, and the gross income was three million one hundred thousand eight hundred and thirty-three francs forty centimes (five hundred and eighty-one thousand seven hundred and seventy dollars). As the average distance performed by each passenger in the first ten months of 1838 is not mentioned in the Report of the Minister, I have supposed the income per passenger per mile to be the same as in 1837, out of which results an average distance of 22.8 miles. In order to show how the traveling public made use of the different classes of cars, the following contains the number of passengers in each class of cars, and the revenue resulting therefrom for the year ending 31st December 1838. During this period there were

17,503 passengers,	I. class,	who paid	69,322 francs 65 centimes.
215,893 "	II. class,	"	702,502 francs 70 centimes.
604,935 "	III. class,	"	1,033,953 francs 05 centimes.
1,343,354 "	IV. class,	"	1,087,790 francs 45 centimes.
56,618 soldiers,		"	45,248 francs 88 centimes.
	For overweight of bag. and freight,		162,015 francs 67 centimes.
2,238,303 passengers and total income,			3,100,833 francs 40 centimes.

These numbers explain sufficiently that the Rail Roads in Belgium are used principally by the lower classes of the people.

IV. Cost of working the Belgian Rail Roads.

The accounts kept under this head contain an exact subdivision of the different expenses occurring in working the Rail Roads; the first general subdivision contains *the maintenance of way and police;* the second *the cost of transportation*, viz. fuel, engineers and firemen, repairs of locomotives and cars, grease for the same, also the expenses for conductors, carriers and baggage men; the third embraces *the general expenses,* viz. clerks and ticket sellers, comptrollers, printing, advertising, office expenses, &c. The annexed table contains the expenses under the different heads:

PERIOD.	Maintenance of way and police.	Transportation account.	General expenses.	Total.	
	FRANCS.	FRANCS.	FRANCS.	FRANCS.	DOLLARS.
From 5th May to 31st Dec. 1835	50,584 01	105,967 88	12,220 84	168,772 73	31,665
Year 1836,	132,637 41	261,778 30	36,719 96	431,135 67	80,888
Year 1837,	345,824 53	664,940 46	144,706 92	1,155,471 91	216,786
From 1st Jan. to 31st Oct. 1838	377,822 58	1,059,180 71	182,186 48	1,619,189 77	303,788
In 3 years and 6 months,	906,868 53 or 27 pr. ct.	2,091,867 35 or 62 pr. ct.	375,834 20 or 11 pr. ct.	3,374,570 08 or 100 pr. ct,	633,127

As this table contains the expenses of working the Rail Roads three and a half years, these numbers may certainly be regarded as the result of a great experience.

V. *Cost of Repairs of Locomotives and Cars.*

In the last table the sum of one million fifty-nine thousand one hundred and eighty francs, seventy-one centimes, appears under the head of transportation account for ten months in 1838. This sum contains the expenses

for foremen in the shops, ...	32,177f. 54c.
For labourers expenses, ...	187,463f. 61c.
At the principal shops in Malines, . . .	54,868f. 72c.
For materials for repairs, ...	87,965f. 66c.
Total,	362,475f. 53c.

or sixty-eight thousand and six dollars, which is 34 per cent. of the expenses of transportation. I believe that the expenses for repairs of engines and cars might be diminished by the introduction of locomotives with moveable trucks in front, and of eight wheeled passenger and freight cars.

VI. *Expenses per Passenger per Mile.*

The accurate number of miles performed by passengers not being contained in the last report, the expenses per passenger per mile can only be found up to the end of 1837. According to the last statement, the expenses from the 5th of May 1835, to the 31st of December 1837, were:

For maintenance of way, ...	529,045f. 95c.
Transportation account, ...	1,032,686f. 64c.
General expenses, ...	193,647f. 72c.
	1,755,380f. 31c.

During the same period the number of passengers reduced to 1 mile was equal to forty-five million ninety-three thousand eight hundred and ninety-nine, which divided in the above ratio gives as the expenses per passenger per mile,

For maintenance of way, . .	1.17 centimes, or	0.22 cents.
Transportation account, . . .	2.29 centimes, or	0.43 cents.
General expenses, ...	0.43 centimes, or	0.08 cents.
Total,	3.89	0.73 cents.

These expenses are very low, and are exceeded on every other Rail Road.

VII. Expenses per Mile of Travel.

The number of miles performed by all the locomotives with their trains was:

From 5th May 1835, to 2d May 1836, . . .	14,810 lieues.
From 3d May 1836, to 31st December 1836, . .	24,825 lieues.
From 1st January 1837, to 31st December 1837, .	61,592 lieues.
Total,	101,227 lieues.

at five thousand mètres, or three hundred and fourteen thousand five hundred and six English miles; the expenses during the same period of two years and 8 months were

		therefore per mile of travel,
For maintenance of way,	529,045f. 95c.	1f. 68c. or 31½ cents.
For transportation account,	1,032,686f. 64c.	3f. 28c. or 61½ cents.
General expenses,	193,647f. 72c.	0f. 62c. or 12 cents.
Total,	1,755,380f. 31c.	5f. 58c. or 105 cents.

The expenses for every mile which a locomotive with its train runs, amount therefore to five francs fifty-eight centimes, or one dollar and five cents, being very nearly the same as on the American Rail Roads.

VIII. Number of Passengers per Trip.

In the table No. III., we have shown that the number of passengers from the 5th of May 1835, to the 31st of December 1837, reduced for the length of a single mile of road, amount to forty-five million ninety-three thousand eight hundred and ninety-nine; during the same period the trains performed three hundred and fourteen thousand five hundred and six miles; this gives one hundred and forty-three as the average number of passengers in a train. This number compared with 5f. 58c. as the expenses per mile of travel, gives again 3.89c. or 0.73 cents as the expense per passenger per mile.

IX. Comparison between the Gross Income and the Net Revenue.

The following table contains the annual gross income, current expenses and the surplus of income over the expenses, as is related in the Report of the Minister, of the 26th of November 1838, to which is annexed the annual surplus for every one hundred francs of the gross income.

Period.	Total gross income.	Current Expenses.	Surplus of the revenue over the expenses.	From 100f. of the gross income remained after defraying all expenses.
	FRANCS. CENT.	FRANCS. CENT.	FRANCS. CENT.	
5th May 1835, to 31st Dec. 1835,	268,997 50	168,772 73	100,224 77	37f. 26 centimes.
Year 1836,	825,132 85	431,135 67	393,997 18	47f. 75 centimes.
Year 1837,	1,416,982 94	1,155,471 91	261,511 03	18f. 46 centimes.
1st Jan. 1838, to 31st Dec. 1838,	2,633,532 21	1,619,189 77	1,014,342 44	38f. 52 centimes.
Total,	5,144,645 50	3,374,570 08	1,770,075 42	34f. 41 centimes.

As an average, therefore, of three and a half years, of every one hundred francs revenue, only thirty-four francs forty-one centimes remained, but as all the locomotives and cars are still new, and no amount for general depreciation appears under the expenses, it is to be supposed, that in future only thirty francs will remain from one hundred. This surplus serves as interest and a sinking fund for the capital.

X. Gross Income per Mile of Rail Road.

The public in Europe is, almost throughout, of opinion, that only short lines, and these especially between two populous cities, will pay a good interest, and that the branch roads extending to remote, less populated, parts of a country will never yield any profit. What results the Belgian roads give in that respect, the annexed table will show:

PERIOD.	No. of sections opened.	Average length of road in operation.	Gross income during the whole period.	Annual income per single mile of road.	
			FRANCS. CENT.	FRANCS. CENT.	DOLLARS.
5th May to 31st Dec. 1835,	1	12.6	268,997 50	32,333 75	6,066
Year 1836,	2	22.3	852,132 85	38,212 23	7,169
Year 1837,	6	56.1	1,416,982 94	25,258 16	4,739
1st Jan. to 31st Oct. 1838,	10	118.7	2,633,532 21	26,638 34	4,998
Total,		53.1	5,144,465 50	27,735 98	5,204

In the second column for the year 1835, appears only the section between Brussels and Malines of 12.6 miles opened at that time. In the year 1836, these 12.6 miles were in operation for three hundred and sixty-five days, and the second section from Malines to Antwerp, of 14.6 miles, for two-hundred and forty-three days only. In multiplying the length of each section by the respective number of days, and dividing the sum by three hundred and sixty-five, we obtain 22.3 miles as the average length in operation during the whole year 1836. In the same manner the average length was obtained for the years 1837 and 1838. The last column shows, that the annual receipt per single mile of road amounted in the first year, when the novelty attracted many passengers, and only 12.6 miles were opened, to thirty-two thousand three hundred and thirty-three francs, seventy-five centimes, and that in the third and fourth year, when curiosity attracted but few, and the greatest number travelled for business only, and while a much greater length of road was in operation, these receipts amounted still to twenty-six thousand five hundred francs per mile yearly. This amount will undoubtedly be increased in the following years, as in 1838 four new sections came into operation, on which the traffic will develope itself only by and by; besides there will be the transportation of goods, which for the year 1839, is estimated to give a revenue of eight hundred and fifty thousand francs for one hundred and fifty-nine miles, or five thousand three hundred and forty-six francs per mile; the gross income on the Belgian Rail Roads, will therefore also in future, like the first year, amount to about thirty-two thousand francs per mile of road annually. That by the increase of population and commerce, also, this income of thirty-two thousand francs will be increased, is evident; the Rail Roads in Belgium serve therefore as a proof, that long lines of Rail Roads may (some extraordinary circumstance excepted,) be executed with equal success as short ones.

It would be quite erroneous in calculating the revenue of a system of Rail Roads, Canals, or Turnpike roads, to regard the income on the principal line separately, and so the revenue of each of the branch lines, in order to judge of the value of each of them. By the opening of a branch line the income of the main line must become greater; because the passengers and freight from the branch lines will pass over the same and increase the revenue. The accurate way of calculating a whole system of Rail Roads, Canals, or Turnpike roads, must therefore be to compare the *total income of the main line as well as of the branch lines*, with the *total length of all the lines*, in order to find the *average income per mile;* and in deducting therefrom the expenses, the balance will show, when compared with the cost of construction per mile, what interest ensues for the capital invested.

XI. Budget for the Operations of the Belgian Rail Roads in the Year 1839.

We have seen that the annual gross income amounts to thirty-two thousand francs per mile, therefore for the one hundred and fifty-nine miles, which are in operation to five million eighty-eight thousand francs. After defraying all the expenses from one hundred francs gross receipts there remain thirty-four francs forty-one centimes, the nett income will, therefore, be one million seven hundred and fifty thousand seven hundred and eighty francs, instead of which the minister in his Budget anticipates the amount at one million seven hundred thousand, to which he is led by a different calculation. This surplus is exactly five per cent. of the capital expended of thirty-four million francs. These five per cent. suffice for interest and sinking fund, and therefore the Belgian Rail Roads fulfil their object, to maintain themselves without being a charge to the State Treasury.

XII. Increase of Income from the Mail and Turnpikes.

As an objection against Rail Roads it was further maintained, that their introduction in a country will lessen considerably the receipts of tolls on turnpike roads and of the mail, because there will be less travel on turnpike roads, and letters will be carried by persons who travel on Rail Roads; the same opinion appears to have existed in Belgium. On the 27th of January 1838, the Minister, Mr. Nothomb, declared in the Senate, that the revenue of the mail in 1837 exceeded that of 1836 by two hundred and sixty-two thousand three hundred and seventy-three francs, and the tolls on turnpike roads by one hundred and ten thousand francs, for the reason that although the tolls on those roads which go in a parallel direction with Rail Roads are lessened, yet they are increased in a greater proportion on those turnpike roads which lead to the Rail Roads, as they are passed over by all who come to travel on the latter. The revenue from the mail increased in consequence of the greater intercourse occasioned by the introduction of Rail Roads.

XIII. Comparison of the Belgian Rail Roads with those in the United States.

According to Table under No. III, the number of passengers during three and a half years, reduced for the length of one mile, amounted on the Belgian Rail Roads to eighty-eight million nine hundred and eighty-one thousand seven hundred and sixty-three, or at an average per year of twenty-five million four hundred and twenty-three thousand three hundred and sixty-one. As the average length of road in operation during the whole time was 53.1 miles, we have four hundred and seventy-eight thousand seven hundred and eighty-three through passengers, annually. The *Belgian Rail Roads are therefore traveled over on their whole length by nearly five hundred thousand passengers per year.* We have now the following comparison:

(*a.*) *Cost of construction.*—A mile of Rail Road with a single track, and the necessary buildings and outfit, costs in America twenty-thousand dollars; in Belgium forty-one thousand three hundred dollars, or more than twice the amount.

(*b.*) *Tariff.*—On the American Rail Roads, a passenger pays at an average five cents per mile; on the Belgian Rail Roads, only one cent or five times less; for freight the charge is, in America, at an average seven and a half cents per ton per mile.

(*c.*) *Speed.*—On the American Rail Roads, passengers are conveyed with a speed of from twelve to fifteen miles per hour, stoppages included, on the Belgian Roads at the rate of seventeen miles, or stoppages not included; at the rate of from twenty to twenty-five miles.

(*d.*) *Traffic.*—There are at an average, thirty-five thousand through passengers, and fifteen thousand tons of goods carried annually over the American Roads; on the Belgian there have been carried per year four hundred and seventy-eight thousand seven hundred and eighty-three through passengers, and the transportation of goods only commenced a short time since.

(*e.*) *Gross income.*—The same amounts on the American Rail Roads, at an average per mile and per year,

From 35,000 passengers at 5 cents, ...	1750 Dollars.
From 15,000 tons of goods at 7½ cents, ...	1125 Dollars.
From mail and contingencies, ...	200 Dollars.
Total,	3075 Dollars.

On the Belgian Rail Roads the gross income per mile from four hundred and seventy-eight thousand seven hundred and eighty-three passengers, and the transportation of freight, amounts to thirty-two thousand francs or six thousand and three dollars seventy-five cents per year.

(*f.*) *Expenses per mile of travel.*—These amount on the American Rail Roads to one dollar, on the Belgian Roads to one dollar five cents, or they are the same in both countries.

(*g.*) *Number of passengers per trip.*—In Belgium there were in each train, at an average of three and a half years, one hundred and forty-three through passengers; on the American roads, a passenger train contains only forty through passengers, at an average.

(*h.*) *Number of trips per year.*—In dividing thirty-five thousand by forty we obtain eight hundred and seventy-five, as the average number of passenger trips per year on the American Rail Roads; and in dividing four hundred and seventy-eight thousand seven hundred and eighty-three by one hundred and forty-three we get three thousand three hundred and forty-eight, which represents the average number of passenger trains passing annually over the Belgian roads. As at the same time the speed on the latter is greater than on the American Rail Roads, it was necessary to employ rails of forty-five pounds per yard, while their weight is generally less on the American Rail Roads.

(*i.*) *Expenses per passenger per mile.*—These are in Belgium only 0.73 cents, and in America two and a half cents, or three and a half times more. The reason of this is, that the American trains contain three and a half times less passengers, while the expenses per train per mile are equal in both countries. It is very nearly the same for a Locomotive to carry forty or one hundred and forty-three passengers in a train.

(*k.*) *Annual current expenses.*—In America the annual current expenses for working a Rail Road, are per mile,

For transportation of 35,000 passengers, at 2½ cents,	875 Dollars.
For transportation of 15,000 tons of goods at 6½ cents,	975 Dollars.
For transportation of the mail and other expenses,	100 Dollars.
Total,	1950 Dollars.

Or sixty-three dollars forty-one cents of every one hundred dollars gross income. On the Belgian Rail Roads, of every one hundred dollars gross revenue, the expenses are sixty-five dollars fifty-nine cents, or per year per mile three thousand nine hundred and thirty-seven dollars eighty-six cents.

(*l.*) *Interest on the capital invested.*—In America the annual average gross income, per mile of Road, amounts to 3075 dollars, the annual current expenses to one thousand nine hundred and fifty, leaving one thousand one hundred and twenty-five dollars; which compared with the cost of a mile of Road (twenty thousand dollars,) give five and a half per cent. interest. On the Rail Roads in Belgium, the annual gross income per mile, is six thousand and three dollars seventy-five cents, the expenses three thousand nine hundred and thirty-seven dollars eighty-six cents, leaving two thousand and sixty-five dollars eighty-nine cents as interest on the cost of forty-one thousand three hundred dollars per mile, or exactly five per cent.

XIV. General Remarks.

The comparison of the results of the Belgian Rail Roads with those of the Rail Roads in the United States of America, speaks evidently in favour of the former. The extremely low charges for passage on the Belgian Rail Roads has increased the number of passengers in an unparalleled degree, and produced an intercourse not attained in any other country of the world. While the higher prices in the better classes of cars yield a considerable profit, the price in the last class, or for the great mass of the people, is so low that it about covers the expenses only. The Belgian Rail Roads are, therefore, throughout, a great popular, democratic establishment, which must have met the approbation of the people, and of every intelligent man; the Belgian Rail Roads afford to the government the greatest facility in the transportation of troops, the importance of which was evinced principally during late years; the Belgian Rail Roads yield, in conformity with the grand idea of their establishment, only the interest and sinking fund of their capital, but the State Treasury has, by the increase of intercourse, indirectly, gained in all taxes, in the revenue from tolls on turnpike roads, and from the mail; the most important gain, however, was that kept in view by the great founder of these roads, to bring the nation into a more intimate contact, and to form of it one large family, on which the actual national device: "L'Union fait la force," ("Union gives strength,") becomes realized.

F. A. CHEVALIER DE GERSTNER.

⁂ Letters to whom may be addressed to the care of Messrs. Maitland, Kennedy & Co., New York.

☞Five francs and thirty-three French centimes are equal to one dollar. One English mile is equal to one thousand six hundred and ten mètres. One pound sterling is equal to four dollars eighty-six cents.

Cincinnati, 25th June, 1839.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1838,
With Remarks and Exemplifications by the Editor.

1. For a machine for *Sawing Shingles;* Elnathan Samson, Plymouth New Hampshire, September 5.

In this machine the sawing is to be effected by a circular saw; the machine, generally, is like a number of others for the same purpose, the claim being confined to the particular construction of the parts concerned in setting the shingle bolt so as to cause a head and point to be alternately sawed.

2. For an improvement in the *Pistons of Steam Engines;* Ellis L. Norton, Hartford, Connecticut, September 5.

(See Specification.)

3. For an improvement in the manner of constructing *Boilers for Generating Steam;* Ellis L. Norton, Hartford, Connecticut, September 5.

(See Specification.)

4. For an improved *Protracting Table,* for Engineers, Surveyors, &c.; William T. Steiger, Washington City, September 7.

This protracting table, which is the work of a practical draughtsman, is well calculated to effect its object, and the assertion of the inventor is undoubtedly correct, "that any line in or about a circle may be projected and correctly measured on the draughting board, and any number of points ascertained in any curve whatever, of which the chords, and their included angles, can be calculated, by actual protraction, with a degree of accuracy and despatch not hitherto attained by the instruments in common use." The description and illustration of the instrument occupy many pages, referring to several drawings.

The claims are to "the manner of connecting the protractor arch, having a fixed centre pin, with a revolving draughting board, and with the parallel and guide strips, regulated in the manner, and for the purposes set forth."

5. For an improved *Spring Draft and Bumpers, for Rail Road Cars;* Peter Alverson, New Haven, Connecticut, September 8.

The patentee informs us that the object of his invention is "to prevent the jerk usually experienced in the first movement of connected cars, and the jar occasioned by the concussion when suddenly stopped, by interposing elastic chains, or spring drafts and bumpers, both made with strong spiral springs, as described, thereby preventing, or greatly lessening, the effect both of the jerk and of the concussion."

The elastic chain, or spring draft, consists of an apparatus of strong spiral springs coiled around stationary, and sliding rods under each end of the car; the chains, or links, by which the cars are connected, being attached to the sliding part of this apparatus, will necessarily, to a certain extent, produce the intended effect. The bumpers, or elastic cushions, are to be attached in the usual manner to the front and rear draw bars of the carriage bed of each car, and these also are to derive their main elasticity from similar spiral springs, coiled upon rods of iron in their rear. The claim is to "the combination of spiral springs with the other machinery, as specified."

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6. For an improvement in *Fire Plugs and Hydrants;* John M. Jorden, Baltimore, Maryland, September 8.

Various plans have been devised for the purpose of letting off the waste water of a hydrant, to prevent its freezing, and that before us can scarcely be called an invention, it being merely a modification of the ordinary mode, namely, the turning a cock below the surface of the ground, which, whilst it cuts off the supply from the water pipe, allows that contained above said cock to run out, and to be absorbed by the earth. The claim made is to the "particular manner" of arranging the part by which this is effected.

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7. For *Applying Electro Magnetism as a Motive Power;* Solomon Stimpson, City of New York, September 12.

It has been satisfactorily ascertained by numerous and well conducted experiments, in the hands of persons of competent scientific knowledge, that the attainment of an available motive power by the electro magnetic influence, is a thing not to be hoped for, in the present state of our knowledge upon that subject; and that although we have much to learn concerning this agent, we have no ground, by reasoning from what we do know, to justify the hope that the steam engine will eventually give place to the electro magnetic power. After this it is hardly necessary to remark that all the instruments hitherto constructed for this purpose have proved to be failures, so far as practical utilitarianism is concerned. That before us depends for its action upon a change of poles, in a manner common to most of its compeers; but it was thought that the particular arrangement of the parts, presented sufficient novelty upon which to base a claim, and a patent was therefore granted for it; but this will not protect it from the fate which has overtaken, or awaits, the whole brotherhood. A year ago, applications for patents, were numerous, and many caveats were entered, for the purpose of protecting the inventors of such machines, but many months have passed over, as we believe, without any new device having been offered, and we are glad of it, because we think that those who might be induced to continue such attempts for profit, would be destined to encounter certain loss.

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8. For an improvement in the mode of *Fastening Bedsteads;* Laurens Kent, Dorset, Bennington county, Vermont, September 12.

The rails of the bedstead are to be halved, or lap jointed together, and the posts are to be in two parts, one of which is to have a screw upon it, which is to pass through a hole in the middle of the lap-joint—and this is to screw into the opposite section of the post. This mode of fastening is the thing claimed, but we much doubt its being extensively adopted.

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9. For a machine for *Shelling Corn;* Rufus Porter, Billerica, Middlesex county, Massachusetts, September 12.

It rarely happens that we meet with a machine intended to effect some object to which numerous others have been applied, which does not belong to one or other of the families into which they may generally be divided, but we have here a corn shelling machine which we believe to be *sui generis.*

A pulley, or wheel, is made to revolve, which has a hollow shaft, or centre, the opening through it being sufficiently large to admit an ear of corn to pass freely. Three straps of steel are bent so as to form elastic springs, one end of each of which occupies a part of the opening in the shaft of the pulley, passing each other so as to form a triangular aperture in the middle of the opening. A hook, or tooth, is formed upon the end of each of the springs, and when the corn is fed in between them, these hooks, or teeth, separate the grain from the cob, the elasticity of the springs adapting them to ears of different sizes. As the cob passes through, it is seized between two revolving cylinders furnished with teeth, which draw it forward. The claim is to the "construction of the shelling wheel as above described, and in combination therewith, the shafts having spikes on their surface, in the manner, and for the purpose described."

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10. For a machine for *Removing Snags and Sawyers from the beds of Rivers;* Henry M. Shreeve, St. Louis, Missouri, September 12

This machine, which has performed good service on the Mississippi and other rivers, consists of two steam boats so connected together as to form a twin boat, each division of which is furnished with a powerful steam engine, and propelling wheels of the ordinary construction. Near the forward end of the two boats there is what is called a snag-beam, made of great strength, and armed with iron; this is firmly connected to each boat, and is the instrument by which the trees are to be raised, or broken off. For this purpose the boat is put under full way, and so directed as to bring the snag-beam forcibly up against the tree, which is sometimes broken off and floats away, and is sometimes raised from its hold on the bottom, in which case it is drawn up by means of powerful windlasses, worked by the steam Engine, and deposited on a cradle formed between the two boats, where it is cross cut, and then thrown into the water, to float off.

The claims are to "the manner of combining and connecting the mechanical power of the windlass and the pulley, so as to co-operate with the momentum given to the twin steam boat, and with the continuous action of the paddle wheels, so as to break off, uproot, and raise, snags and sawyers, as above set forth. I, however, particularly claim as new, the application of the snag-beam, for the purpose of raising or breaking the snag, or sawyer, preparatory to its being lifted on board the boat by the apparatus constructed for that purpose. I also claim the manner of connecting together the two boats by means of the upper and lower tier of beams, diagonal braces, bulk head, and the forward beam."

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11. For improvements in a *Machine for Rolling, Shaving, Softening, and Finishing, Leather;* Thomas Chace, City of New York, September 12.

The leather to be rolled, &c. is placed upon a concave bed, where it is held by clamps, and the roller, or tool, which is to pass over it is connected to a vibrating frame, swung like the lathe of a loom. The lower bar, called the traverse bar, of this frame, allows the apparatus carrying the roller to be slid along it, so as to act upon all parts of the concave bed.

Rolling machines operating in a manner somewhat resembling that before us are not new, and the claims in the present case are limited, therefore, to the peculiar manner of constructing certain parts of the apparatus, namely to a spring lever by which the roller and traverse bar are governed, in combination with said traverse bar.

12. For an improved *Summer and Winter Cooking Stove;* Philo P. Stewart, City of New York, September 12.

The description of this stove is of considerable length, setting forth its construction and supposed advantages; and the sectional and other drawings extend to seventeen figures. To adapt it to summer and winter use there are several parts which are to be changed, so as either to confine the heat, or to suffer it to escape into the room. It is likewise to be adapted to the burning of either wood or coal. The patentee claims "the arrangement and form of the fire place, as combined and acting within the oven; and the arrangement and action of the heating flues," and of several other parts, not to be understood by the mere announcement of them, and not presenting any thing very distinctive in character.

13. For an improvement in the mode of *Attaching Sleigh Runners to wheel Carriages;* Henry G. Guyon, City of New York, September 13.

The wheels of two, or of four, wheeled carriages are to be secured upon runners, by means of substantial clamps, and the claim is to "the attaching of sleigh runners to wheels of carriages in manner substantially as described." We cannot furnish any particulars of the invention, as we do not find any thing particular in it; most workmen could devise ways of effecting the same purpose equally original and meritorious with those pointed out; the difficulty will be in getting the thing into use so as to be paid for it.

14. For an improved *Cooking Stove;* Philip Wilson, Springfield, Hampden county, Massachusetts, September 13.

The claim made under this patent consists in the particular manner of giving a curvature to the grate bars, and to the combination of the respective parts of the stove as a whole.

15. For an improvement in *Wind Mills;* Israel Keyes, Putney, Windham county, Vermont, September 14.

This wind-mill is to have a wind wheel consisting of vanes, or wings, placed upon a vertical shaft, and this is to be enclosed within a cupola of vertical slats turning upon pivots at each end, so that the apertures between them may be increased or diminished according to the force of the wind; the opening and closing of the slats are to be effected by a governor, which may be made to act by centrifugal force, like those most commonly used in steam engines, wind mills, &c.; when water is to be pumped up by the mill, a simple, but ingeniously constructed, water governor, which is described, may be used, its action depending upon the quantity of water raised by the mill. The claim is to the application of a regulator to the wind mill by means of a cupola of blinds, the slats of which are movable on their axes; the whole being combined and operating as described."

The self regulating action has been applied to wind mills of various kinds, and in various ways; the novelty, therefore, consists in the application thereof to this particular kind of mill, in the manner set forth.

16. For a *Boat for Traveling on Ice;* Thaddeus Chapin, Canandaigua, Ontario county, New York, September 14.

Boats with sails, and runners for traveling upon ice are well known devices, but the boat here described is to have paddle or propelling wheels in addition to runners, the peripheries of said wheels being armed with spikes to take hold on the ice. They are also to operate as propelling wheels in case of the breaking of the ice. The motive power may be steam, or any other which is preferred.

The claim is to " the combination of a boat, or other water-tight body, supported on sleigh runners, with a shaft, and wheels roughened on their treads, turned by steam, or other, power, for propelling the same over ice."

Such a boat may no doubt be made to travel upon ice; but possibility, and eligibility, are not always companions, and we apprehend that in the present case they will not be found to coalesce, even on our northern lakes, and in long protracted winters. The objections and difficulties are so numerous and palpable that they need not be urged.

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17. For an improvement on the *Rag Duster*; Enoch Burt, Manchester, Hartford county, Connecticut, September 14.

This duster resembles that in use in having a centre shaft furnished with pins, or beaters, and with stationary pins projecting inwards from the interior of its periphery; but in addition to the centre shaft there are two others midway between it and the periphery of the duster, which shafts have similar pins, or beaters, projecting from them. To these latter shafts a rapid vibratory motion is to be given, which is effected by placing a spur wheel on the centre shaft immediately outside of one of the heads of the cylinder, and allowing a pinion to gear into this wheel, which pinion carries a crank pin, connected by rods with cranks on the ends of the two auxiliary shafts. The claim is to these auxiliary shafts, or bars, extending through the duster, and causing the pins in them to vibrate, or reciprocate, between the stationary pins both in the shaft and ribs; and their combination with the common duster, as set forth.

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18. For a machine for *Grooving, Moulding, and Sawing Boards;* Frederick Fredly, Sugar Valley, Centre county, Pennsylvania, September 15.

In this machine the cutters which are to form beads, mouldings, tongues, or grooves, and by which sawing also is to be effected, are to be placed upon revolving shafts turned by means of a winch. The frame work of the cutters is to be a traveling carriage which is to run upon ways, the board being stationary and clamped firmly so as to be acted on by the cutters. " The invention claimed and desired to be secured by letters patent, consists in the mode of tongueing and grooving, and beading boards, &c., by means of revolving cutters which work in a frame that travels on ways between which the boards to be operated upon are clamped; said frame having a gauge to regulate the cut of the cutters."

It is a very easy task to construct a machine upon paper, and to tell how it will operate, but a practical trial frequently gives entirely new views of the matter, and such we apprehend will be, or has been, the history of this machine. To form correct cutters for mouldings, which shall operate upon the periphery of a wheel traveling in the way described, is no easy matter, and we are of opinion that, in most cases, the hand of the workman would be found far preferable to the proposed machine.

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19. For an improvement in the *Plough;* David Prouty and John Mears, Boston, Massachusetts, September 15.

The improvements in this plough which form the subject of claims, are the manner of affixing and protecting the point of the coulter. The manner of applying the locked coulter by an opening on the land side, and the manner of applying the brace so as to secure the beam and land handle, unite with the mould board handle, and adjust the position of the beam.

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20. For a machine for *Extracting Stumps and Raising heavy Bodies;* Roswell H. Hall, Branchport, Yates county, New York, September 15.

A platform fixed upon runners, or skids, that it may be moved about from place to place, has a vertical iron bar rising from its centre, its upper end being supported by a gallows, and revolving on gudgeons at either end. Said bar may be three inches in diameter, and it has a loop, or eye, at its upper end, to admit a strong lever, or sweep, by which it is to be turned, thus constituting it a vertical windlass. The two ends of a rope are to coil round its lower part, and pass through pulleys which are connected to two opposite stumps, or other resisting bodies, when by turning the shaft one of them is to be removed.

The claim is to the above described arrangement of ropes and pulleys in combination with the windlass.

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21. For a process for *Alloying Metals by Cementation;* M. Sorel, Paris, Kingdom of France, September 17.

(See Specification.)

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22. For a machine for *Cleaning Wool from Burs, &c.;* Theodore Ely, Poughkeepsie, Dutchess county, New York, September 17.

"The wool to be cleaned, after being assorted in the usual way is fed by hand to the machine, in which it passes between a pair of rollers, which I prefer to make of copper, although they may be made of any other metal, or even of wood; but there appears to be a peculiar adaptation in the texture of copper, so far as my experience has extended. The uppermost of these rollers is borne down by a spiral or other spring which enables it to adapt itself to the varying thickness of the sheet of wool passing between the pair.

"To remove the burs from the wool as it passes between the rollers, I employ a plate, or blade, of steel, which stands in front of the upper roller, its lower edge being nearly opposite to the line of junction of the two rollers, and its back side nearly touching the upper roller. This plate is made adjustable, sliding up and down in grooves, which receive its ends; it does not stand vertically, but is inclined from its upper edge towards the rollers.

"The lower edge of the steel plate is to be turned by a burnisher, like a currier's knife, which will have the effect of enabling it to catch against the burs, &c. A revolving fan, back of the rollers, blows off the wool as it passes through."

The claim is to "the use of the steel plate, or blade, with its lower edge turned as above described, and operating in combination with the metallic or other rollers, for the purpose and in the manner set forth."

23. For a machine for *Thrashing and Winnowing Grain;* Reuben W. Currier, East Kingston, Rockingham county, New Hampshire, September 17.

The thrashing part of this machine does not present any thing particular, but consists of a cylinder set with teeth, and working into a concave similarly armed. The novelty consists in the particular manner of forming and arranging the endless belts for carrying off the straw, and for riddling the grain. There is what is denominated a conductor situated below and back of the thrashing cylinder, up which the straw passes to an endless belt by which it is carried off, the grain falling through its meshes upon a second endless belt, and being acted on by a fan wheel. There is more novelty of form than substantial difference from others, in this machine. The claim is to "the conductor in combination with the two carrying belts."

24. For a machine for *Tearing and Dusting Rags,* and other materials used in the manufacture of paper; Henry Clarke and William Albertson, New London, Connecticut, September 19.

There are to be one or two shafts of circular saws, fixed in the manner of those for roller gins, the saws being about two inches in diameter, and half an inch apart; these are made to revolve so as, by the aid of combs, to tear the rags, whilst revolving brushes serve to keep the saws clean; a screen under the whole serves to aid in separating the dust. The rags are to be fed up between rollers, by the aid of an endless apron.

Claim.—"We claim as our invention the aforesaid combination of the shaft and circular saws, and blocks, when combined with the combined fans and brushes, and the feed rollers and apron, and the screen and comb by which the rags are torn, dusted, and prepared for the engine."

25. For an improved *Eccentric Brake, for arresting the motion of Railroad Cars;* Ephraim Morris, Bloomfield, Essex county, New Jersey, September 19.

Between the two wheels on each side of a car there is to be a cam wheel, one part of which is to be a segment of a circle, resembling the periphery of one of the wheels; another portion of the periphery of the cam is in a straight line, probably of two feet or more in length, and the cam may be made to roll round on its circular, or curved part, and to bring this straight part upon the rail, which, whilst it bears upon it, will lift the wheels, at one or both ends, therefrom. The straight portion of the cams are furnished with flanches which embrace the rail. This part by its friction upon the rail is to operate as a brake upon an inclined plane, or elsewhere. The claim is to the foregoing arrangement of the respective parts.

When it is desired to relieve the brake, this is effected by backing the cars, when the ordinary wheels are made to rest upon the rail, the lower side of the brake being then free from them; there are, of course, some particular devices described which we have not noticed, nor do we think it necessary, being apprehensive that the contrivance is not destined to be adopted.

26. For an improvement in the *Mortar for Dressing Rice;* Jamie-

son Cordes, a citizen of the United States, residing in London, England, September 19.

This patent is taken for an improvement in the mortar employed in dressing, or redressing, rice; the patentee says:—"now, whereas the mortars heretofore used in dressing rice or paddy, have been made as smooth as possible inside, which I have found does not dress the grain either so quickly, or so well, as when the inside of the mortar is rough, or so formed as to prevent the grains next to the side of the mortar from slipping upon the down stroke of the pestle, as readily as those at a distance from the sides of the mortar. And whereas many means may be adopted for making the inside of the mortar rough, or uneven enough to obtain the object, I therefore claim, as my invention, a mortar for dressing rough rice, or paddy, or for redressing rice, the interior surface of which is formed as hereinbefore described, or otherwise formed with recesses or impediments, or made rough or uneven, in such manner as to effect the object hereinbefore explained, namely, of more effectually causing the detention or partial detention, of the outer grains from ascent, in order that they may be rubbed against by the inner ones the more effectually, during the action of the pestle."

In the drawing, that part of the mortar which is occupied by the upper portions of the rice, is represented as formed into angular ridges, the vertical section of which would be like saw teeth.

27. For an improved *Cooking Stove;* Jordan L. Mott, City of New York, September 19.

This stove in its general form, resembles the old fashioned ten plate stove, but differs from it materially in its interior arrangements. The claims are the following:

"My claims consist in making the bottom, sides, and flanches of the fire box, in one single piece, for the purpose of preventing the warping of the plates, and the escaping of ashes into the oven. I claim the particular manner of conveying the draught round the oven, so as eventually to carry it up in front on each side of the fire place door, in divided flues. I claim the manner of constructing the air heating flues on each side of the fire box, in connexion with the mode of admitting it into, and of allowing it to escape from, the oven."

28. For a machine for *Cutting the Teeth of Circular Saws;* Thaddeus Sellick, Haverstraw, Rockland county, New York, September 19.

One, two, or more, steel plates, prepared to have teeth cut upon them, are to be placed upon a vertical spindle capable of revolving on its two ends. These plates are to be made to bear against a revolving cutter, consisting of an endless screw, the thread of which is in such form as to cut a saw tooth. A cutter two inches in diameter and half an inch in thickness, has been used for the purpose. The revolution of the cutter will cause that of the saw plates, which are borne up against it. It is remarked that the teeth of straight saws may be cut by a similar device.

"What I claim, is the employment of a circular revolving cutter, having a thread or channel on its periphery, running in the manner of an endless screw, and so arranged and combined with the other parts of the machinery employed, as to cause the cutter to cut, and to feed the plates to itself, by its own action, the whole operating substantially in the manner above set forth."

29. For constructing and using *Fishing Seines;* Cyrus Tracy, Savannah, Georgia, September 19.

The nature of this invention is said to "consist in drawing a seine under the fish, or holding it in an extended position, till such fish as move at the surface of the water, and in a direction with the tide or current, shall have passed into it, when the seine is closed, and the fish secured." The claim is to the particular manner of using the seine, as described.

30. For an improvement in the mode of *Covering the Roofs of Buildings with Sheet Metal;* J. B. Duval, City of Charleston, South Carolina, September 19.

"The object of my invention, is to lay on the tin plate in such a manner as shall allow a free expansion and contraction of the metal, whilst the whole covering is effected without the use of solder in any part; or the driving of nails through any of that portion of the tin which constitutes the covering." It is stated that the mode adopted by the patentee is analogous to some which have been previously known, but "the difference of my mode of procedure and that in which the edges of the tin are curved up, and slit tubing is passed over them, or other analogous means of allowing for expansion and contraction will be apparent, as I allow for it effectually with all the seams closed down by the mallet."

31. For an improvement in the mode of *Preserving Timber;* Edward Earl, Savannah, Georgia, September 20.

We published in our last number, the specification of a patent for a similar purpose, the gentleman above named being one of the patentees. The mode of procedure in the present case is like that described in the former patent; that is, the timber is to be boiled in the solution by which the preservative quality is to be communicated, which solution is to consist of sulphate of copper, (blue vitriol,) and sulphate of iron, (copperas,) dissolved in water. One part of sulphate of copper to three of sulphate of iron, are to be taken, and about three pounds of the mixed salts added to every gallon of water. The timber after being bored through its length, is to be boiled, and afterwards suffered to cool in this solution. The claims made, are to "the boiling of timber as described, in a solution of sulphates of iron and of copper; applying this solution to the interior as well as the exterior of the timber, by means of the central perforation when the size of the timber requires it, as the most effectual mode of protecting it from the ravages of insects, and of rot. I do not claim the saturating of timber by a solution of sulphates in water when applied cold, but confine my claim to boiling it, as above set forth, in that solution, during from two to five or six hours, or more."

We think that most of our remarks on the former patent, are equally applicable to that before us.

32. For a machine for *Sticking Sash Stuff;* Caleb B. Rogers, Norwich, Connecticut, September 20.

The sticking is to be effected by revolving cutter wheels, the stuff being held, and advanced against the cutters by suitable means; in which there is but little of novelty, the form and construction of the cutter wheels, constituting the entire claim. The patentee has probably secured the right to his peculiar manner of constructing this part, so as to hold the cutters, but other arrangements equally good, may be readily devised.

33. For an improved mode of *Setting Sugar Kettles;* James Malory, New Orleans, Louisiana, September 20.

This patent is taken for substituting rings of cast iron, in place of the bricks usually employed in forming the projecting ridges between, and surrounding sugar kettles, in the ordinary mode of setting them. The claim is to "the employment of rings of cast iron in the setting of sugar kettles, as set forth."

34. For a *Mortising Machine;* Erastus M. Shaw, City of Baltimore, Maryland, September 22.

There are so many patented mortising machines, that nothing is left for new ones but to vary the modes of making the adjustments for holding the stuff, advancing it, and working the chisels; and these minor arrangements are rarely of sufficient importance to merit particular description. Such is the case in the present instance.

35. For a *Paddle Wheel;* Isaac McCord, Harrisburg, Pennsylvania, September 22.

A number of inconveniencies and bad properties are ascribed to the ordinary paddle wheel, which the one now patented is intended to obviate. To some of the evils complained of, we do not admit the ordinary wheel to be liable, nor do we perceive the utility of all the so called improvements in that before us. We are told that the bucket which has last entered the water, leaves but little for the next bucket to act upon, as it forms a hollow space, by scooping the water out of the way; now if the boat were not making progress, something like this might occur, but in a boat that is under way, the successive paddles enter a new portion of the fluid. But we have not space for such discussions. In the wheel, which is the subject of this patent, the part within the paddles is to be an enclosed drum, and the ends of this drum, or heads of the wheels, are to form projecting rims extending out to the edges of the paddles. Between each paddle, there is to be a fluted roller extending from head to head of the wheel, which, among other good works, is to prevent ice and drift wood from getting between the paddles; the main object, however, of said rollers we do not understand, as they are placed, it is said, "for the purpose of excluding air in part from the buckets, in order that they may more completely fill with water."

The buckets are to be "prismoidal," that is to say, thicker at their inner than they are at their outer edges, that they may have the less tendency to lift water; and they are to be defended by bars of iron bent into a semicircular form, and stationed around the lower part of the wheel.

"The invention claimed, and desired to be secured by letters patent, consists in the combination of a wheel for propelling steam or other boats made of plank, or iron heads or ends, and a circular rim with prismoidal paddles, and fluted rollers placed between them in the manner and for the purpose above set forth; and also the arrangement of the semicircular ribs of iron for protecting the wheels, as above described."

36. For a machine for *Cleaning Feathers;* Samuel G. Ladd, Hallowell, Kennebec county, Maine, September 22.

The feathers are to be introduced into a double cylindrical case; the space between the two cylinders is to be filled with steam, and the feathers within agitated by a revolving shaft furnished with rods, or beaters. One end of the cylinder is to have a movable head, and the claim is to "the movable head; by removing which, I am enabled to cool and receive the feathers after the operation of cleansing is over." This is rather a small claim, as a door in the bottom would, we think, answer the end proposed; but numerous feather dressers had been previously patented, and these, we suppose, had run away with the whole invention, with the exception of this movable head.

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37. For a machine for *Hulling Rice, Barley, &c.;* Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, September 22.

A vertical, cylindrical vessel is to receive the grain to be hulled, and this vessel has in it a revolving shaft which carries metallic arms, there being similar, but stationary arms projecting inwards from the vessel. A lid, or cover, is to be forced down by a screw so as to subject the grain to any degree of pressure required, and the shaft is then to be put in motion. The claim is to "the agitating of rice or other grain to be hulled by revolving and stationary arms, whilst the grain is subjected to a considerable degree of pressure in a cylindrical, or other suitably formed vessel, in a manner substantially the same with that herein set forth."

When we first saw the model of this machine, we thought the proposed plan to be one of great feasibility, and hoped much from it. The idea of hulling in this way we thought new, and still believe that it is so; the project however, has been fairly tried, and has proved a failure, and a really good rice hulling machine is still, therefore, a desideratum; all those in use being chargeable with certain defects.

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38. For a machine for *Sawing Shingles;* William Bell, Lexington, Kentucky, September, 22.

The timber is to be cut into proper lengths for a shingle, and a block so prepared, is to be placed in a box of a particular construction, by which it is held, and presented to the saw, which is stretched in a frame working between fender posts, the plane of the saw being parallel to that of the frame. The manner of holding the block, and of shifting it so as to cut heads and points, would require too many words for its description, but the whole exhibits considerable novelty. The claims are confined to the particular manner of constructing or operating the respective parts, and would not, without the drawing and description, convey any distinct idea of them.

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39. For an improved *Gas Meter;* Samuel Clegg, City of London, Great Britain, September 22.

We must refer the curious in this matter, either to the English journals, devoted to the publication of patents, or to the patent office, for particular information. Mr. Clegg was a pioneer in the construction of gas meters, and much is due to him for the skill which he has manifested in the prosecution of this business; the original and the present meters are, as might well have been anticipated, essentially different from each other. The claim will render this manifest to any one acquainted with the old meter.

"I claim exclusively the instrument or combination above described, for measuring gas, composed of one or more balances, formed of one pair, or several pairs of globular or other shaped vessels, each pair being united by a tube and partly filled with alcohol or any other fluid which boils at a low temperature, and submited to the action of jets of gas at different temperatures; this gas being heated before it arrives at the vessel, containing the said balances, by a flame of gas, or by any other convenient means."

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40. For a machine for *Sawing Shingles and Clapboards;* Thomas J. Flanders, Bradford, Merrimac county, New Hampshire, September 22.

The history and mystery of this machine are really too long for its subject, and the more especially so as the matters of fact contained in it are not new in themselves, whatever of novelty they may possess in their particular arrangement. The shingles and clapboards are to be cut by a circular saw, and the matters described are principally those concerned in holding and shifting the stuff, so as to cut heads and points, and thick and thin edges.

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40. For a *Permutation Lock for Doors, Vaults, &c.;* Robert Newell, City of New York, September 25.

The general description of this lock, would serve for a considerable number of others, as there is "a combination of slides and tumblers operating together on the bolt, in such manner that they can be transposed or set in any given position to which the key may be formed, the bit of the key being composed of as many movable sections as there are slides in the lock." The claims relate, of course, to the particular manner of constructing, arranging, and changing the movable, or permutation portions of the lock, which is not a thing for verbal description. We have examined one of these locks, which was made in a manner to do great credit to the skill of the workman, whilst the arrangements were such as promised permanence, and seemed fearlessly to throw down the gauntlet to the picker of locks.

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42. For *Metal Combs;* Richard A. Ives, Bristol, Connecticut, September 25.

A strip of sheet metal is provided, of a width equal to that of the intended comb, and of a thickness equal to that meant to be given to the teeth; this metal is to be bent, or plaited, in a zig zag manner crosswise, the bends being of such width only as shall adapt them to the forming of a single tooth; this crumpling, or bending, may be effected in the first instance by rollers, resembling crimping rollers; these plaits are then to be pressed up together, whilst a similar piece is interposed between each plait, to form the spaces between the teeth; this being removed, ribs are to be soldered on each side of the crumpled plate, to form the middle or back of the comb; the metal on each side is then to be cut away, to liberate the teeth, and the comb is to be finished up by filing, buffing, &c. The claim is to the foregoing mode of forming metallic combs.

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43. For a machine for *Sawing Staves;* William Lacy and Solyman Merrick, Springfield, Hampden county, Massachusetts, September 25.

This machine is a modification of what has been called the barrel saw, which consists of a barrel-formed metallic body, one end of which is furnished with saw teeth, for the purpose of cutting the stave into the proper form; a body of this kind is made with difficulty, and for barrels of the ordinary size is too long to run steadily, at the distance of the teeth from its bearing. In the case before us there are two such saws, each of them being of the length of half of the barrel only. The patentees say, "the nature of our improvement consists in the use and application of two hollow conical saws, of about half the length of the stave to be sawed; these saws commence sawing at each end of the block or stave, and proceed sufficiently near to the centre to separate the stave from the block. The objects to be attained by our improvement are as follows; to reduce the amount of timber wasted by the cut of the saw, by reducing the thickness of the plates of which the saws are composed in proportion to the reduced length of the saws; and also to reduce in like proportion, the amount of power necessary to saw a given number of staves; also to saw staves with great facility."

The details of the manner of working the two saws, and of holding and advancing the timber, are clearly given and represented; these, however, any competent machinist could readily devise, the merit of the invention consisting in the two saws. The machine is in good hands; we are not, however, informed respecting its operation, but are inclined to think well of it.

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44. For a machine for *Dyeing Yarn from the Beam;* William Spencer, Lowell, Massachusetts, September 25.

By means of the apparatus described, the yarn is wound from one yarn beam to another, and in its passage is conducted, over rollers, down into a vat containing the dye, within which vat it passes under a drum, or slatted reel, and in emerging from the dye, the yarn passes between squeeze rollers, and over a drying cylinder. "By changing the application of power from one of the beams to the other, and back, the yarn may be passed forwards and backwards through the dye any number of times that may be required." Each separate thread of the yarn occupies a groove in a roller, as it passes backwards and forwards.

The claim is to "the combination of the slatted reel with the reeds, grooved rollers, and squeeze rollers, and steam cylinder, and the application of said combination to the beam of yarn, for the purpose of passing the yarn through a dye vat, and dyeing and replacing it on the beam."

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45. For an improvement in the *Flyer* for spinning flax, hemp, manilla, &c.; Henry Evans and Barnabas Churchill, Plymouth county, Massachusetts, September 26.

"The invention is two regulators for spinning at a given rate, introduced within the flyer of a spinning machine, as shewn in the drawing." The claim is to "the application of these two regulators within the flyer of a spinning machine, as herein described, for regulating the spinning of all kinds of hemp, flax, and manilla." The regulators consist of small drums, &c., around which the yarn passes, but the detail of their construction, and mode of action, cannot readily be shown without the drawings.

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46. For a *Roller Gin,* for Ginning long staple, and other cotton; Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, September 27.

The ginning rollers of this machine are usually made of metal, and they have ridges and depressions running their whole length, like the threads of a many threaded screw. They are placed horizontally in pairs, in such manner as that the ridge of one roller shall enter the depression of its fellow; these rollers are to be driven by whirls, or by any suitable gearing.

Several modifications of this roller gin are described, and a claim is made to "the forming of spiral channels upon the rollers of the roller gin for ginning cotton."

47. For a rolling mill for *Rolling Circular Saws, Saw-gin Plates, &c.;* Eleazer Carver, Bridgewater, Plymouth county, Massachusetts, September 27.

This rolling mill is intended principally for rolling the plates of cotton-gin saws, which saws are composed of two semicircular plates, which when put together form the circular saw, with a large opening in the centre, for the shaft. The rollers are two steel cones on the ends of two shafts, geared together by bevel wheels in a suitable frame. By passing the steel plates between these rollers they will be unequally stretched at their two edges, and may be made to assume the required form. The claim is to "the combination of the conical rollers with the gauge plate, as described."

48. For *Extracting Colour from Dye Wood:* Laurens Kent, Dorset, Bennington county, Vermont, September 27.

(See Specification.)

49. For an improvement in the *Apparatus for making Coffee and Tea;* Antoni Bencini, Milton, Caswell county, North Carolina, September 27.

The claim is to "the construction and use of an apparatus for making coffee or tea, in which there is a receptable for cold water for condensing the aromatic portion which escapes from the heated vessel."

A coffee pot is made of tin, &c., in the ordinary form, and the coffee is to be boiled in this pot, as usual, but only in about two thirds of the quantity of water to be employed; over the hind part of the coffee pot is a barrel-shaped receptable into which the remaining third of the water is to be put, cold. A tube with a stop cock, leads from the bottom of this receptacle into the coffee pot, and on the upper side of it there is an opening into which passes a tube which leads from the top of the coffee pot into the cold water, passing down near to its bottom. When the coffee is boiling the steam is conducted through this tube, and eventually brings the cold water to the boiling point, which will be known by the escape of steam from the upper opening; the pot is then removed from the fire, the stop cock turned, and the water from the receptacle allowed to run into the coffee pot, charged, it is said, with the aroma which is ordinarily lost. During the boiling the spout of the coffee pot is closed by a cork.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for an improvement in the Pistons of Steam Engines; granted to ELLIS L. HORTON, *Hartford, Connecticut; September 5th,* 1838.

To all whom it may concern: Be it known, that I, Ellis L. Horton of the City of Hartford, in the county of Hartford, and State of Connecticut, have invented a new and improved mode of constructing the pistons of Steam Engines; and I do hereby declare that the following is a full and exact description thereof.

My improved piston is of the kind which is intended in general to operate by means of an expanding metallic packing, but my improvement is not necessarily confined to those pistons with a metallic packing but may be employed in all cases where it is desired to cause the elastic force of the steam to act within the body of the piston, and force the packing against the cylinder. My improvement consists in the employment of two valves, one on the upper and one on the lower plate of the piston, when used in a vertical cylinder; each of these valves opening inwards so as to admit steam to pass in freely on either side where its pressure may operate, and to prevent its escape at the opposite side.

Fig. 3.

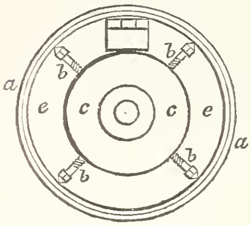


Fig. 2.

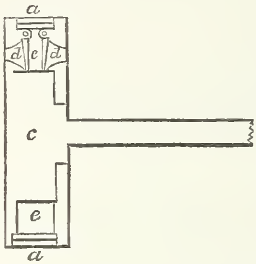


Fig. 1.

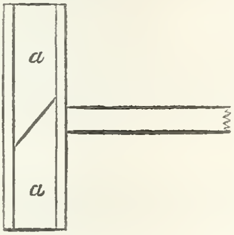


Fig. 1, in the accompanying drawing, is a side view of said piston for a horizontal engine. Fig. 2, is a vertical section through its middle, and fig. 3, a view of the interior, the front plate being removed: *a*, *a*, are hoops, or flat rings, of steel, or other metal, one within another, divided so as to allow them to adapt themselves by their elasticity to the interior of the cylinder; *b*, *b*, fig. 3, are set screws which are intended to keep the segments of the interior hoop, when divided into segments, in place, they are tapped into the hub, or centre *c*, *c*, of the piston.

In fig. 2 and 3, *d*, *d*, are the valves opening inwards, one of them only being shown in fig. 3; the other being attached to the front plate; *e*, *e*, is the chamber within the piston into which the steam is admitted, and within which it acts upon the interior of the packing, forcing it against the cylinder, and counteracting its tendency to pass between the two.

What I claim as constituting my invention, is the employment of two valves, one in the upper or front plate, and the other in the lower or back plate, of the piston, to admit steam on either side, in the manner and for the purpose herein set forth, without confining myself to the particular form of the valves, or to the position of the cylinder, whether vertical or horizontal.

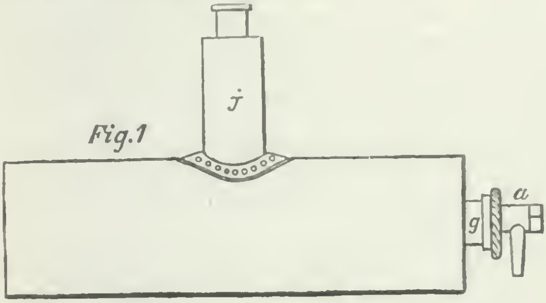
Ellis L. Horton.

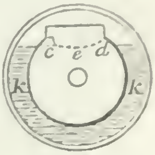
Specification of a patent for an improved Steam Boiler; granted to Ellis L. Horton, *Hartford, Connecticut, September 5th,* 1838.

To all whom it may concern: Be it known, that I, Ellis L. Horton, of Hartford, in the county of Hartford, and State of Connecticut, have invented certain improvements in the manner of constructing boilers for generating steam, and I do hereby declare that the following is a full and exact description thereof.

The exterior form of my boiler is that of the ordinary cylinder, but within this I place what I denominate a movable steam reservoir, or chamber, which occupies a large portion of the space within the cylinder, but between which and the cylinder there is to be a stratum of water of three or four inches, more or less, which is exposed to the direct action of the fire upon the outer case, or cylinder; by which means, as experience has shown, the generation of steam is augmented, whilst the quantity of water to be carried is much diminished.

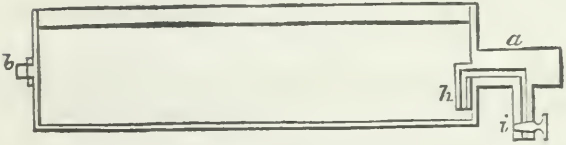
Fig.1

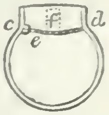




4.

2.





3.

In the accompanying drawing fig. 1, shows the exterior of the boiler. Fig. 2, a side view of the reservoir. Fig. 3 an end view of the same, and fig 4, a cross section of the boiler, and of the reservoir within it.

The reservoir is suspended, centrically, within the cylindrical case, or boiler, by the shafts, or pivots *a* and *b*. The main body of it is cylindrical, as shown in the section fig. 3, on its upper side it is open from *c*, to *d*. which opening extends its whole length, and is of sufficient width to allow a man to pass into it from the man hole in the boiler, for the purpose of cleaning or repairing either the boiler or reservoir; there are projecting sides along the opening, as shown in the figures, and these are to rise so as nearly to touch the inside of the boiler. A concave lid, shown by the dotted line *e*, is hung on centres on one side, as at *c*, this is made of the same curvature with the reservoir, in order that it may be folded back within it. and occupy but little room. When raised up, it forms a channel to carry off any water which may foam over the sides of, and would otherwise pass into. the reservoir. A pipe rises from the lid *e*, and is shown by the dotted lines *f*; this prevents the running of water into the boiler through the opening, or openings, which must necessarily be left in it for the passage of steam. In boilers where the water does not foam, the lid *e*, may be omitted.

The shaft *a* of the reservoir is hollow, and passes through a stuffing box *g*, in the boiler head. It is made square at its outer end, where the requisite power may be applied to turn it round when required. A tube, or pipe *h*, *i*, passes through the hollow shaft, and is bent twice at right angles as shown in the drawing; it reaches down nearly to the bottom of the reservoir at *h*, and has a stop cock at *i*, by which it may be opened or closed at pleasure; by means of this device an opportunity is afforded of blowing off any water which may accumulate in the reservoir from the condensation of steam, or from any other cause. *j* is the steam drum, and *k*, *k*, the water space between the reservoir and the boiler. In each of these figures like parts are designated by the same letters of reference.

It will be seen that the close approach of the sides of the open part of the reservoir, to the cylindrical boiler, will tend to prevent the passing of water into it, even where the foaming is considerable. I will remark, however, that if it is at any time preferred to use this boiler without employing the reservoir as a steam chamber, it may be advantageously done, water being allowed to rise in the reservoir to the ordinary water line of a boiler; and I have found that when so used steam is still generated with greater rapidity than in cylindrical boilers without such an appendage. When thus used the pipe *h*, *i*, may be employed as a supply pipe, and the water injected through it, will have much less effect in checking the supply of steam than when injected directly into the boiler.

Having thus fully made known the manner in which I construct my improved cylindrical steam boiler, I now declare that what I claim as my invention, and wish to secure by letters patent, is the construction and use of the movable reservoir, suspended upon pivots, or gudgeons, and made, and operating, substantially in the manner herein set forth.

Ellis L. Horton.

Specification of a patent for a process for Alloying Metals by Cementation; granted to M. Sorel, *of Paris, in the Kingdom of France, September 12th*, 1838.

To all persons to whom these pesents shall come, M. Sorel, of the Kingdom of France, gentleman, sends greeting. Be it known that I, the said Sorel, have invented, constructed, made and applied to use, a new and useful process for alloying metals by cementation, applicable particularly to the preservation of copper, iron, and other metals, and also operating a change in their outward appearance, and giving them more gloss; which process is specified in the words following, viz:

The said process consists in alloying the surface, or even the mass, of copper either with *zinc*, *tin*, *lead*, *or other metals more fusible than copper*, and capable of being alloyed with the same. These various metals may either be employed singly or in combination, but I have obtained the best results, in every respect, from the use of zinc alone. By an analogous process, I also alloy iron and other metals, as herein fully described and made known.

The mode of cementing zinc with copper may also be employed for the cementation of other metals: I begin by scouring the metal I wish to alloy, or cement; I surround it afterwards with pulverized charcoal and zinc. The zinc is prepared for that purpose by forming an alloy between the said metal and iron, which alloy may be easily reduced into powder. Zinc minutely divided by other means may also be employed.

The copper, thus surrounded, or covered, is placed in a furnace, where it is to be raised to a red heat, and the same temperature must be kept up during a longer, or shorter, period of time, according to the dimensions of the pieces of copper operated upon, and the depth to which it is desired to operate the cementation. It it, however, proper that the operation should not last too long, as, on the copper, there might then be formed a coating of brass, which would be liable to corrode, and to produce verdigris; which defect may be obviated in two ways—1st, by stopping the operation before the alloying between the copper and the zinc be completely effected, and 2d, by sifting pulverized zinc over the substances which cover the copper, a few minutes before it is drawn from the fire.

In the process of cementation, just described, instead of the pulverized zinc, thin sheets of zinc may be substituted, or even lapis calaminaris. When it is not required that the cementation should penetrate deeply into the copper, this metal may be previously coated with zinc, according to the usual process of tinning, and then submitted to the cementing process as above described.

This process of cementation is applicable to all metals in the rough or the finished state, such as copper, brass, bronze, melchoir, or German silver, and is of much importance in metallurgy. Among thousands of applications, may be mentioned the preservation of the copper sheathing of ships, the preservation of medals and other precious articles of bronze, the cleanliness, and consequently the salubrity, of culinary utensils.

It is worthy of remark that zinc, which by itself is so easily corroded by acids, becomes quite proof against sulphuric acid in the cold state, let it be ever so concentrated, provided the cementation of zinc and copper be stopped at the proper point to avoid the formation of brass; while, on the other hand, zinc alloyed by fusion with one half, or one third, of its weight of copper is dissolved by sulphuric acid as rapidly as if it were pure and unalloyed.

The application to iron of the process of alloying by means of cementation is to be next explained: this process preserves iron from rust, and, moreover, gives to wrought, or to cast, iron, the appearance of gold, or of silver.

With an alloy of copper and zinc in different proportions, and by prolonging the operation, more or less a gold or silver colour is given to the iron operated upon. These colours are brilliant and lasting, and do not produce verdigris, and the metal resists the action of sulphuric acid more or less diluted with water. The process is as follows, and consists of two operations, which though analogous in their effects, are yet different from one another.

Firstly, the iron must be covered by immersion in the fused metal which is intended to be used as a coating: *secondly*, the iron must be alloyed by means of cementation, with the metal which has been thus made to cover it. This last operation, gives to the coated metal new properties, and renders its surface more smooth.

To coat iron with an alloy of copper and zinc, I melt about two parts of copper with three parts of zinc, and I dip in this alloy, while in a fused state, and covered with borax, or other suitable flux, the pieces of iron I wish to prepare. These pieces must be well scoured, or previously coated with zinc. If the pieces be very massive, they must be heated before being dipped in the fused metal. By way of lessening the quantity of borax necessary to the process, a saturated solution of this flux may be made, and brought to the boiling point, and the pieces are then immersed in this solution, before being introduced into the fused metal. When extracted from the melted metal, the pieces of iron will not have yet assumed the colour of copper, and their surface will be rough, but a second operation imparts to them the proper colour, and removes the asperities.

The second operation is as follows: the pieces of iron which have been submitted to the first operation, must be covered with powdered charcoal, and exposed to a red heat, for a longer or shorter space of time, according to the colour and the result to be obtained. The iron is better preserved from rust when the operation is rapidly effected, but in that case the colour is not so good.

The pieces of iron must be drawn from the furnace along with the charcoal which covers them, and in that state immersed in water, and allowed to cool.

The second operation may be effected in a reverberatory furnace.

The same process may be modified so as to dispense with the previous coating of zinc given to the iron: to effect this, an alloy of zinc and copper is made with the same proportions of each metal, indicated for the first process. When cool, this alloy must be reduced to powder in a mortar, and a certain quantity of borax must be added. The pieces of iron to be operated upon, must be scoured, and covered with a greasy, or viscous substance, or merely wetted with water; they are next strewed with the pounded alloy and borax, and finally imbedded in powdered charcoal in the same manner as in the second part of the first process; they must be heated long enough to allow the excess of zinc to evaporate. It is easy to ascertain that the operation is terminated when only a small quantity of vapour escapes from the mass. The pieces of iron are then drawn from the fire and thrown, while red hot, and still covered with charcoal, into water. After this immersion, the iron is completely coated with copper, the brilliancy of which may be increased by dipping it into nitric acid containing a little soot: it may then be burnished, polished, and even gilded, exactly as if it were massive copper.

I shall finally describe a second modification of the process for alloying iron with another metal by cementation: first, scour the iron perfectly, immerse it in a solution of sulphate of copper, and let it remain therein during a greater or less period of time, according to the thickness of the copper coating which it is desirable to obtain; the copper precipitates on the iron, and when the covering is sufficiently thick, the pieces operated upon must be taken out of the solution and covered with very fine clay, softened in water; over this are strewed borax and zinc, pulverized and mixed together: instead of strewing borax and zinc powder in this way, a paste may be made with clay, borax and zinc powder, and the pieces of iron be covered with the same.

The pieces of iron are next to be buried in powdered charcoal, and exposed, during a few minutes, to a white heat. They may then be withdrawn from the fire, and they will be found to be covered with a coating of the alloy, containing a greater or less proportion of zinc, according to the proportion contained in the powder employed, and the duration of the process.

What I claim as my invention, and desire to secure by letters patent, is the manner herein described of cementing copper, and other metals, or mixture of metals, with zinc, in the manner, with the limitations, and for the purpose, set forth. I also claim the manner of protecting iron, by the process, or processes, herein fully described and made known, together with such modifications of said process, or processes, as are substantially the same in their nature and effects. M. SOREL.

Specification of a patent for a Process for extracting the colour from Dye Woods; granted to LAURENS KENT, *Dorset, Bennington county, Vermont, September* 27*th*, 1838.

To all whom it may concern: Be it known, that I, Laurens Kent, of Dorset, in the county of Bennington, and State of Vermont, have invented a new and improved mode of extracting the colour from dye woods, by steam, or distillation, rendering or reducing the same to a gum or powder; and I hereby declare that the following is a full and exact description.

The nature of my invention consists in extracting the colour from dye woods, reducing the same to a gum, or powder, in a pure state, and in greater quantity than can be produced in the common way of boiling. To enable others skilled in the art, to make and use my invention, I will proceed to describe the same.

I construct a steamer, or tub, sufficiently large to contain four or five hundred pounds of ground wood, said tub standing on its end; eight inches from the bottom I fix a fine strainer, the tub above the strainer is then filled and made perfectly tight; through the centre of the head I enter my steam pipe from the boiler or still, which is of brass or copper; the steam condenses in the wood, and leaches into the space below the strainer; strong liquor is thus drawn off and put again into the boiler, and the water or liquor run off again into the wood, as before, leaving the colouring substance in the boiler, which is taken out and dried. As the colour or gum of some dye woods cannot be exhausted perfectly with water, I sometimes make use of alcohol, and in that case I enter a worm below the strainer, seven inches from the bottom of the tub, to condense the alcoholic steam that comes through the wood.

What I claim as my invention, is the manner herein described, of extracting the colour from dye woods, by steam and distillation, reducing the same to a gum, or powder, in a pure state, separate from the wood, to be used in dyeing and staining.

LAURENS KENT.

Description of sundry machines used in the manufacture of Silk, as improved by Mr. GAMALIEL GAY; *said several improvements having been secured by letters patent of the United States.*

Mr. Gay has furnished us with cuts of his improved machinery, for the manufacturing of silk, with a request that a brief description of them may be inserted in the Journal, a request with which we most cheerfully comply, as the subject is one that has for some time past excited a very extended and intense interest; and the adaptation of our country to the production of the raw material, is no longer to be considered as problematical. It is the design of the Editor to give descriptions of any other machinery used, or proposed to be used, in this branch of business, and which may appear worthy of particular notice.

Fig. 1, in the accompanying engravings is a machine for unwinding silk from the cocoons, and winding it upon spools, or bobbins. The vessel *a*, is for containing the warm water in which the cocoons are immersed, and which is kept at a proper temperature by being placed over the furnace *b*. The silk passes from the cocoons over wire loops at *c*, *c*, and thence to wire loops, or eyes *d*, *d*, *d*, these latter being fixed to traversing bars, *e*, *e*, on either

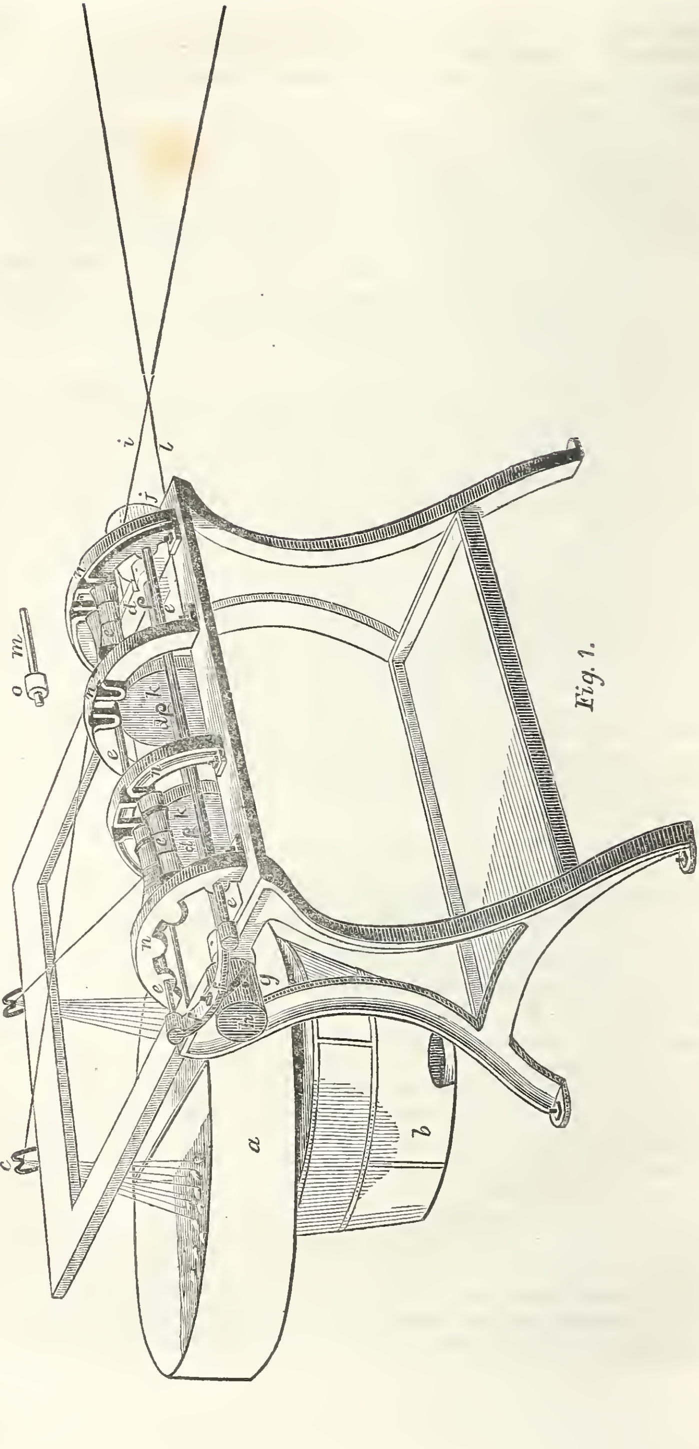


Fig. 1.

side of the machine; these bars are connected together by pieces of metal *f*, extending from one traversing bar to the other. To cause these bars to traverse there is an oblique groove *g*, in the hub *h*, into which a pin enters that projects down from the piece *f*. The hub *h*, is on a shaft which passes from end to end of the machine, and is made to revolve by means of a band *i*, *i*, on the whirl *j*; upon this shaft, also, there are wheels *k*, *k*, which give motion to the spools, or bobbins *e*, *e*. The spool is put upon a spindle *m*, the ends of which fall into grooves on the arches *n*, *n*, *n*, the collar *o*, rests upon the wheel *k*, the revolving of which causes the spool to revolve.

Fig. 2, is a machine for doubling and twisting the silk after it has been wound upon spools or bobbins; and fig. 3, is a top view of said machine. The bobbins *a*, *a*, *a*, are placed upon pins rising vertically from the top, *b*, *b*, of the machine; from two or more of these bobbins, the silk is carried round a roller, which is denominated a delivering roller; these rollers are shown at *c*, *c*, *c*, and one of them drawn larger, and separate from the machine at *d*; they are made of iron, and are turned with a hollow, or concave round the middle of them, and around this the silk is to have one or two turns, in its passage to the spindles. The gudgeons on the ends of these rollers fall into notches in the frame of the machine, and their periph-

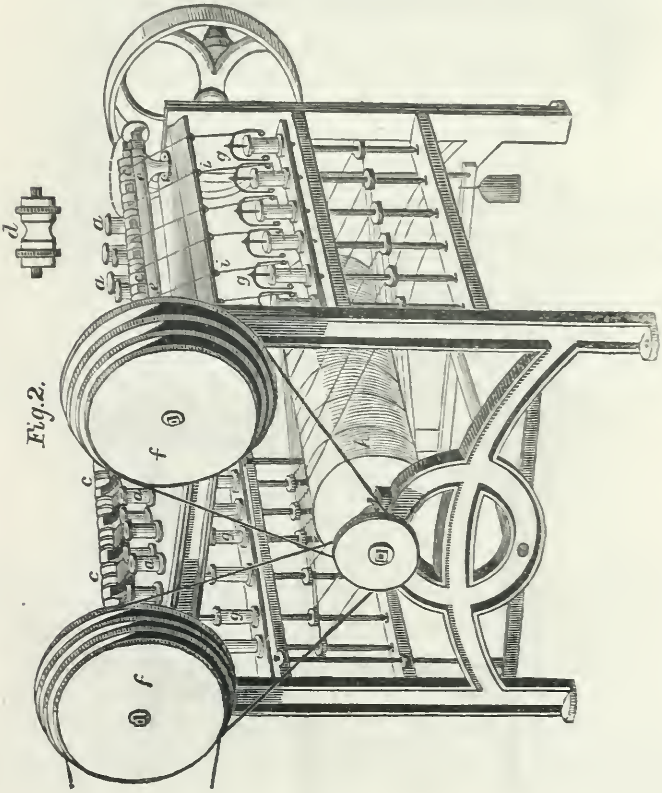


Fig. 2.

eries rest upon round shafts *e*, *e*, which are made to revolve by means of the whirls *f*, *f*. The dark lines on these rollers, represent bands of leather which surround them, and which come into contact with the shafts *e*, *e*, and afford the degree of adhesion and friction requisite to give them motion,

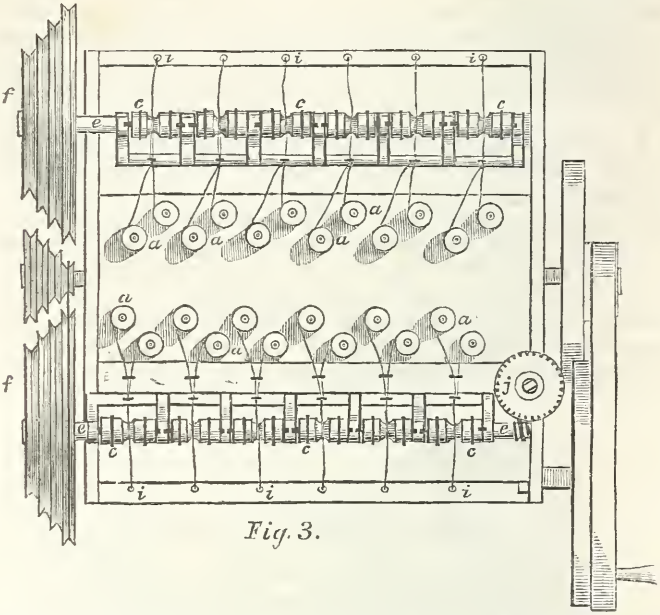


Fig. 3.

and to give a proper degree of tension to the silk. From these rollers the silk passes to the flyers and spools *g*, *g*, *g*, fig. 2, which are carried by bands from the drum *h*, in the usual manner; in its passage from the delivering

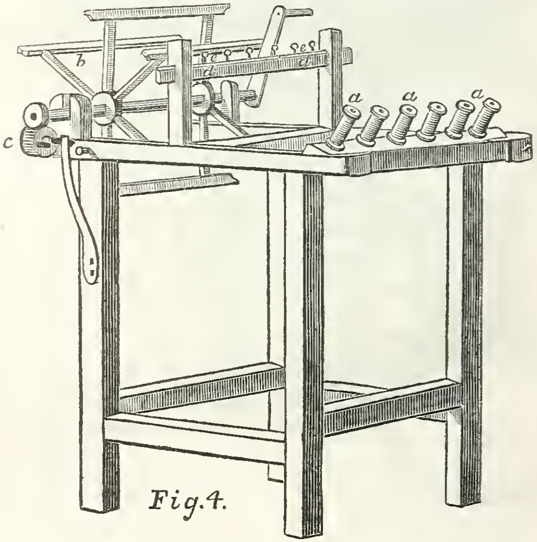


Fig. 4.

rollers to the spools, the thread passes through wire loops i, i, i. The traversing of the spools up and down is effected by a vane rail, operated on by the heart motion, as in numerous other machines, the toothed wheel j, gearing into an endless screw governing this motion.

Fig. 4, is a machine for winding the silk into skeins, after it has been doubled and twisted for sewing silk. The bobbins upon which the silk has been wound are placed upon pins at a, a, a; the reel b, is of the proper size for the skein, and attached to its shaft at c, there is the well known apparatus to give notice when a sufficient length has been reeled to form a skein. When this takes place, a shifting bar d, d, which carries the wire loops e, e, is slid along to a short distance, which will cause the next set of skeins to occupy another part of the reel.

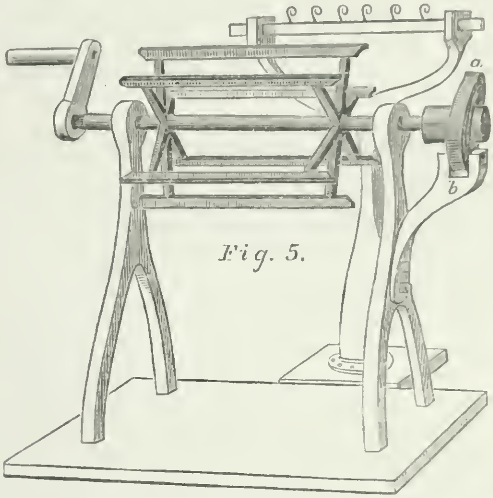


Fig. 5.

Fig. 5, is a reel having a traversing motion, which traversing motion is given by means of a wheel a, formed by cutting a cylinder obliquely to its axis at such an angle as will cause the reel to traverse to the extent desired. The periphery of the wheel a, is received within a notch on the guide piece b, the effect of which will be apparent.

Specifications of English Patents.

Specification of a patent, granted to William Dolier, *of Liverpool, for his invention of a certain durable surface or tablet for the purpose of receiving writings, drawings, or impressions of engravings or other devices capable of being printed, which surfaces may be applied for roads or pavements, and parts of which invention may also be used as the means of strengthening and beautifying glass.*—[Sealed 30th August, 1838.]

My invention of a certain durable surface or tablet, for the purpose of receiving writings, drawings, or impressions of engravings or other devices capable of being printed, consists, firstly, in the application of a well known composition or material as a durable tablet or surface for receiving writings or drawings, and which may be removed at pleasure by moisture. This composition or material is common glass enamel, made in the ordinary manner from flint glass, borax, and arsenic, and which I roll out in thin plates of any required dimensions, exactly similar to manufacturing plate glass; and after it has been ground and polished, I remove the glazed surface by grinding with the finest emery powder, and then the tablet is ready for use. This permanent tablet will now be found capable of receiving the finest writing or drawing, and also beautifully adapted to receive paintings and impressions, exactly in the same manner as ornamenting china by painting or transfer.

This improved tablet will be an elegant appendage to various domestic purposes and furniture, and may be manufactured into sideboards, billiard tables, table tops, and all other similar ornamental purposes; and may have either a highly polished, or a dead, surface, and may be composed of any variety of colours by altering the ingredients of the enamel, which is well understood.

My second improvement in a durable surface, is in rendering the same perfectly pliable, and still rendering such surface durable. This is composed by a foundation of a sheet of linen, silk, cotton, or other cloth, linen being preferable, to be coated or covered upon one side with a mixture or composition, and treated as follows:—Spread upon the reverse side of the sheet of linen, one coat of a size or varnish, made by dissolving one pound of buffalo skin in one gallon of water over a slow fire, and let the other side, when dry, be rubbed with pumice stone, in order to remove all inequalities, and leave the surface perfectly smooth. This surface is now to be coated three times with a mixture of the purest white lead, called flake white, with boiled linseed oil and spirits of turpentine, in about the proportions of one pound of white lead to one quart of oil and half a pint of turpentine. After this has become perfectly dried, the flexible surface is ready for use, and is most suitable for printing, and particularly advantageous for receiving impressions of maps or charts for marine and general purposes, as being permanent and durable. The back or reverse side of this prepared cloth may be flocked with pulverized woollen cloth in the usual manner of flocking paper hangings, which will improve its appearance and make it more suitable for ornamental purposes. Gold, silver, or bronze surfaces may also be given to the cloth thus prepared, by giving it a coat of the buffalo size, and dusting the metallic powder over it.

Thirdly, these improvements are applicable to roads and pavements for bath-rooms and other similar situations, or tesselated pavements, where damp or wet is liable to get between the joints of the pavements, and form unhealthy and improper secretions; and consist in putting together squares of such enamelled surfaces as first above described, or common bath tiles in squares in different colours and devices, and cement or cover the joints with a light coating of glass enamel fused over the joints in order to render them perfectly secure; and in all situations where cleanliness and beauty are required, this will be found particularly useful.

A further application of this invention may be made by having engraved or printed maps, or other designs, made upon the under side of plates of glass, and vitrifying the glass to render the design permanent, and paving rooms with such plates or squares for the purposes of recreation; and also by inserting rails of glass, either in bars, rods, or plates set edgewise in grooves or sleepers of wood or metal, making such rails either portable or permanent, and also intended as applicable to various amusements which may thus be pursued in gardens or other situations.

The fourth feature in my invention relates to the strengthening and beautifying glass, and consists in preparing sheets or plates of glass in the usual manner, and placing between two plates a metallic web of wire, wrought into any form or design that may be desired, and then partially fusing the glass so that the glass shall run between the meshes or interstices of the metallic design, and thus consolidate or embody the whole into one plate of glass, with the metallic design in the centre.

The metallic web or design may be formed of either plain net, or any other elegant scroll work or other design, and be composed of brass plated, or other metallic wire, and cast into any form or device which shall be required, and the glass fused around it, and rolled or pressed in the ordinary manner of manufacturing plate glass.

Another adaptation of these improvements is particularly applicable to ornamental windows and casements, where the glass is not required to surround the metal upon all sides. A suitable casting is to be prepared in brass, iron, or other metal, of the exact form of the window frame required; for instance, an ornamental Gothic window, and this casting is to be the framework of the window. The glass is then to be cast in its fluid state into the metallic framing, and may either be rolled of such a thickness that the metal frame shall be in the centre of the plate of glass, or it may be rolled down until the glass shall only fill the interstices of the metallic framing; and thus in either case, the whole of the panes or compartments, of an ornamental window may be made in an entire piece, and of any variety of form, strength, or beauty. The glass is afterwards to be annealed in the usual manner, and then submitted to a bath of cold linseed oil, which is to be caused gradually to boil, and after removing from the fire and allowed to cool, which will thus form a second annealing, and also regulate the expansion and contraction of the metals. The glass is to be ground up and polished in the usual manner, and may either be made bright for windows, or rendered opaque to be employed for all useful and ornamental purposes for furniture, to be used instead of the finest marbles, and with equal beauty and effect.

This combination of metals with glass, for the purpose of increasing its strength, will be of material importance for "dead lights" for all marine purposes, and also forming perpetual window blinds; and it will be evident that great strength may thus be given to glass for windows and such similar purposes by either of the processes above described.

Lond. Jour. of Arts & Sci.

Specification of a patent granted to Eugene Richard Ladislas De Breza, *of Paris, in the kingdom of France, now of the county of Middlesex, for his invention of a chemical combination or compound for rendering cloth, wood, paper, and other substances indestructible by fire, and also preserving them from the ravages of insects.*—[Sealed 20th February, 1838.]

The chemical compound alluded to in the title of this patent, consists of the following materials, and is mixed in the following proportions:—For linens and unbleached goods, take two pints and a half of water, and after raising the temperature to 190 degrees of Fahrenheit's thermometer, add one ounce of alum, with one ounce and a half of sulphate of ammonia, half an ounce of boracic acid, one drachm of glue, the best and finest that can be procured, and add to the whole one drachm of starch dissolved in a small quantity of water.

Before the starch is added, the temperature of the mixture should be raised to at least 212 degrees of Fahrenheit; care should be taken that the several ingredients are introduced in the order above mentioned, and also that each one is dissolved in the water before the next is added. The mixture being thus prepared, the goods to be preserved are operated upon in any suitable manner; for instance, plain unbleached goods may be immersed in the compound, and be allowed to absorb as much as possible, after which they must be pressed or wrung hard, in order to get rid of the redundant liquor; they are then dried in any convenient manner. Printed goods, when the colours are fast, may be treated in the same manner; but when the colours are not fast, the mixture should be applied with a sponge, care being taken that they are not wetted too much, otherwise the colours may perhaps run.

When timber is to be operated on, it is to be put into tanks and covered over with the mixture, which is raised to a temperature of at least 160 degrees.

For preserving paper or pasteboard, the mixture may be put into the vat containing the pulp from which the paper or pasteboard is to be made, or the paper may be immersed in the mixture after it is manufactured.

When the invention is to be applied to theatrical scenery already in use, sheets of paper prepared in the manner described, should be pasted at the reverse side; but for new scenery the canvas may be steeped in the solution.

It is observed that it is not to be supposed the said composition will render the various articles indestructible by fire, but that it merely prevents them from bursting into flame, and by that means communicating the fire from one thing to another.

In conclusion the patentee states that he is aware that some of the ingredients above mentioned have been used for similar purposes to those which his invention is intended to be applied; but what he claims as his invention, is the making a composition consisting of alum, sulphate of ammonia, boracic acid, glue, and starch, mixed in the above order and proportions, to be applied to various articles; and which composition will render them indestructible by fire, and protect them from the ravages of insects.

Idem.

Specification of a patent granted to JOHN ISAAC HAWKINS, *of the county of Middlesex, for certain improved instruments for facilitating the cure of disease, by administering galvanic influence into the human body; being a communication from a foreigner residing abroad.*—[Sealed 13th March, 1834.]

The invention now under our notice, consists in administering galvanic influence in a mild and gentle manner, in place of the shocks given by the galvanic apparatus at present in use. The patentee has described several ways of administering galvanism under different circumstances for the cure of various diseases, and the apparatus employed, although differing in shape to suit circumstances, is, in principle, essentially the same; we shall, therefore, confine ourselves to the explanation of one or two descriptions. For the cure of toothache, the patentee has an apparatus consisting of two metal plates, one of silver, the other of zinc, the edges of the two being soldered together. The plates must be of a shape and size suitable to go inside the mouth, and be placed upon the gums.

In some diseases the outer skin may be in such a torpid state, as to withstand the gentle effects of the apparatus; in such cases an incision should be made, and the galvanism conveyed direct to the inner skin, by which it will be communicated to the nerves; and the whole system, by this means, be roused from its torpidity into a wholesome and natural state of exertion.

Idem.

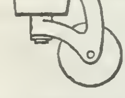
Notice of a patent granted to ANTHONY THEOPHILUS MERRY, *of Birmingham, for his invention of the application of certain white metal plated to certain manufactures, to which it has not hitherto been applied.*—[Sealed 3th March, 1836.]

This invention is merely the application of German silver, or any other alloy of nickel, to the manufacture of silver plated goods, so that when the real silver with which the article is plated shall have partially worn off, the edges or worn parts will still present a bright and silvery appearance. As the method employed in carrying the invention into effect is very similar to that now in general use in plating goods, it will not be necessary for us to describe it, especially as the patentee does not claim it, but confines his invention to the introduction of German silver, or such other white metal in the manufacture of plated goods.

Idem.

Notice of a patent granted to JAMES LUTTON, *of the county of Middlesex, for his invention of certain improvements in castors for furniture.*—[Sealed 25th November, 1834.]

The improvements set forth in the specification of this patent consist in adding a strengthening arm to the horn or bracket of the roller, in order that it may be better able to sustain heavy weights.



The invention, which is very simple, will be perfectly understood by referring to the annexed figure, which represents a side elevation of a castor: a flange or band *a*, forms the upper rim of the castor, as in the ordinary construction; but in this it will be seen that it is made of considerable strength, in order to resist the upward pressure of a collar *b*, to which is attached an arm *c*; and the lower end of this arm terminates in the horn or bracket of the roller.

It will be seen that this construction of castor must possess very great strength, and will consequently be capable of bearing very heavy weights.

Idem.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the relative Strength and other mechanical Properties of Cast Iron obtained by Hot and Cold Blast. By EATON HODGKINSON, Esq.

[With a Plate.]

From the great abundance of the ores which produce iron; from the fortunate circumstance of these ores being frequently found in the neighbourhood of coal and limestone, by which they are reduced to the metallic state; from the great strength of the metal, and the facility with which it can be moulded into any form required—its uses in the arts have become very extensive. Every discovery, therefore, tending to facilitate its production, or to improve its quality, must always be regarded with great interest, whilst distrust and suspicion are likely to be felt respecting any process by which that quality may be supposed to be impaired.

The recent and very general introduction of a heated blast into the smelting furnaces has consequently, as might be expected, given rise to much discussion, and at the same time to great difference of opinion. Iron masters in one part of the country had come to a conclusion that the new process greatly deteriorated the quality of the iron produced, and they rejected it accordingly. Gentlemen from other neighbourhoods, on the contrary, maintained that no deterioration of the metal resulted from the process, which was admitted by all to diminish the expense of its production.

These very different conclusions, drawn by persons largely connected with the manufacture of cast iron, caused the honour of an application from the British Association for the Advancement of Science, at its meeting held at Dublin, to my friend Mr. Fairbairn and myself, requesting us to make a series of experiments tending towards the determination of this matter.

We intended to commence the inquiry immediately, but there was found to be great difficulty in obtaining irons suitable for the purpose; a matter which will be adverted to in Mr. Fairbairn's report, where a description of the irons used will be given.

In the prosecution of this research it was conceived desirable to subject the metals operated upon to more than one species of strain, in order to elicit their peculiar properties; and accordingly they were generally broken in the following three modes:—

1st. By tension, or tearing the metals asunder in the direction of their length.

2nd. By compression, or crushing specimens of different lengths, and various forms and sizes of base.

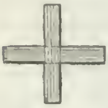
3rd. By a transverse strain, and this under different forms of section.

In this last mode of fracture some bars have been broken under various temperatures, and others have been loaded for a very long time with weights, nearly as large as would have broken them at once, and they are still bearing the loads.

The experiments on the transverse strain (excepting those on the Carron iron, No, 2, the Devon, and the Buffery, of which I read an account at Bristol) were made by Mr. Fairbairn, who undertook also the experiments on the effects of temperature and time. I was desirous that he should try the effect of time upon loaded bars, being convinced that it would do little or nothing to destroy their power of bearing a dead weight; having arrived at his conclusion from experiments made in a different way upon malleable iron. As I was present at many of Mr. Fairbairn's experiments, I may mention the great care and ability with which they were made; they will form the subject of the next paper.

The experiments on the tensile and compressive forces of the metals, and those on the transverse strain read at Bristol, were made by myself and are given below.

Tensile strength of Hot and Cold Blast Cast Iron.—To determine the direct tensile strength of the different kinds of cast iron made use of in these experiments, a model was made of the same form as that I had previously used in some experiments on cast iron, of which a notice was given in the Cambridge volume of the Association. The castings from this model were very strong at the ends, in order that they might be perfectly rigid there, and had their *transverse* section for about a foot in the middle of the form annexed. This part, which was weaker than the ends, was intended to be torn asunder by a force acting perpendicularly through its centre. The ends of the castings had eyes made through them, with a part more prominent than the rest in the middle of the casting where the eye passed through. The intention of this was that bolts passing through the eyes, and having shackles attached to them by which to tear the casting asunder, would rest upon this prominent part in the middle, and therefore upon a point passing in a direct line through the axis of the casting.



Several of the castings were torn asunder upon the machine for testing iron cables belonging to the Corporation of Liverpool. Others were made in the same manner but of smaller transverse area; these were broken by means of Mr. Fairbairn's lever, which was adapted so as to be well suited for the purpose.

The form of casting here used was chosen to obviate the theoretical objections made by Tredgold and others against the conclusions of former experiments.

The results are in the following table:

Results of Experiments on the Tensile Force of Cast Iron.

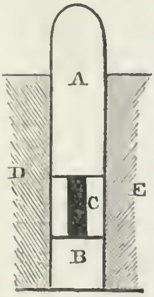
Description of Iron.	Area of section in inches.	Breaking weight in lbs.	Strength per square inch of section.	Mean in lbs. per square inch.
				Tons. cwts
Carron Iron, No. 2, Hot Blast,	4.031	56000	13892	13505=6 0½
Do. do. do.	1.7236	22395	12993	
Do. do. do.	1.7037	23219	13629	
Carron Iron, No. 2, Cold Blast,	1.7091	28667	16772	16683=7 9
Do. do. do.	1.6331	27099	16594	
Carron Iron, No. 3, Hot Blast,	1.7023	28667	16840	17755=7 18½
Do. do. do.	1.6613	31019	18671	
Carron Iron, No. 3, Cold Blast,	1.6232	22699	13984	14200=6 7
Do. do. do.	1.6677	24043	14417	
Devon (Scotland) Iron, No. 3, Hot Blast,	4.269	93520	21907	21907=9 15½
Buffery Iron, No. 1, Hot Blast,	3.835	51520	13434	13434=6 0
Do. do. Cold Blast,	4.104	71680	17466	17466=7 16
Coed-Talon (N. Wales) Iron, No. 2, Hot Blast	1.586	25818	16279	16676=7 9
Do. do. do.	1. 45	28086	17074	
Do. do. Cold Blast,	1.535	30102	19610	18855=8 8
Do. do. do.	1.568	28380	18100	

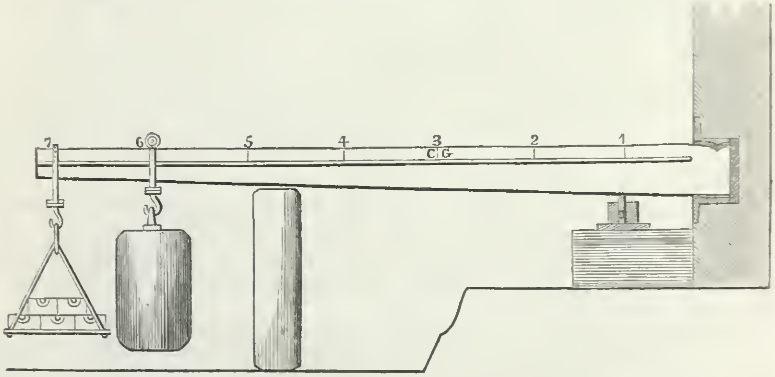
Compression, or the power to resist a crushing force.—In these experiments I shall confine myself to the resistance of short specimens; crushing, with few exceptions, only such as will break without bending. And if I should appear to pursue this and some other matters beyond the strict limits of the inquiry respecting the strength of hot and cold blast iron, I trust it will be excused, as my wish is to obtain some fixed principles where we have nothing but doubt and uncertainty.

The tensile strength of cast iron is still a matter of dispute: the few direct experiments by Mr. Rennie and Captain Brown give from 7 to 9 tons per inch, results not widely differing from those above; they are noticed with some suspicion by Mr. Tredgold (Essay on strength of Cast Iron, pages 91 and 92), who concludes from reasoning on the transverse strength of cast iron, according to the theory which he had adopted, that the direct tensile strength must be 20 tons or more. Mr. Barlow too, whose reasoning has better foundation than Tredgold's concludes, whilst he gives these gentlemen's results, that the strength must be upwards of 10 tons per square inch, (Treatise on the Strength of Timber and other Materials, art. 123). I am not aware of any objection which can be brought against the tensile results given above, except some slight error which Mr. Barlow conceived (in his earlier work on the Strength of Timber, &c.) might arise from the use of testing machines, and that, in this case, would affect but four of the experiments, all the rest were made upon Mr. Fairbairn's lever. I hope to explain the cause of this difference of opinion among our ablest inquirers at a future meeting.

The resistance of materials to a crushing strain is equally a matter of doubt. Rondelet found *(Traité de l' Art de bâtir)* that cubes of malleable iron, and prisms of various kinds of stone, were crushed with forces which were directly as the area, whilst from Mr. Rennie's experiment, both upon cast iron and wood, it would appear that the resistance increases, particularly in the latter, in a much higher ratio than the area, (Mr. Barlow's Treatise, Art. 112.,) I have endeavoured, by repeating with considerable variations the ingenious experiments of Mr. Rennie, to arrive at some definite conclusions.

In order to effect this, it was thought best to crush the object between two flat surfaces, taking care that these were kept perfectly parallel, and that the ends of the prism to be crushed were turned parallel and at right angles to their axis, so that when the specimen was placed between the crushing surfaces its ends might be completely bedded upon them. For this purpose a hole 1¼ inch diameter was drilled through a block of cast iron about 5 or 6 inches square, and two steel bolts were made which just filled this hole, but passed easily through it; the shortest of these bolts was about 1¼ inch long, and the other about 5 inches; the ends of these bolts were hardened, having previously been turned quite flat and perpendicular to their axis, except one end of the larger bolt which was rounded. The specimen was crushed between the flat ends of these bolts, which were kept parallel by the block of iron in which they were inserted. See fig. where A and B represent the bolts, with the prism C between them, and D E the block of iron. During the experiment the block and bolt B rested upon a flat surface of iron, and the rounded end of the bolt A was pressed upon by the lever. There was another hole drilled through the block at right angles to that previously described; this was done in order that the specimen might be examined during the experiment, and previous to it, to see that it was properly bedded.





The accompanying sketch will show more clearly the mode of performing the experiment, in which the lever was always kept as nearly horizontal as possible. Other apparatus, not here shown, was used to lift up or lower the lever during the experiments.

The results are given in the following tables:

Tabulated results of experiments made to ascertain the weights necessary to crush given cylinders, &c., of Cast Iron, of the quality No. 2, from the Carron Iron Works. The specimens in the first three columns of results, both in the hot and cold blast irons, were from cylinders cast for the purpose and turned to the right size; the $\frac{1}{2}$ inch from those of about $\frac{3}{4}$ inch, &c.

TABLE 1st.—HOT BLAST IRON.

Height of Specimens.	Cylinder, $\frac{1}{4}$ inch diameter; Crushing weight.	Cylinder, $\frac{3}{8}$ inch diameter; Crushing weight.	Cylinder, $\frac{1}{2}$ inch diameter; Crushing weight.	Cylinder, .64 inch diameter; Crushing weight.	Right prism, base a square $\frac{1}{2}$ inch the side, cut out of an inch square bar; Crushing weight.	Right prism, base a rectangle 1.00×.26 inch, cut out of the middle of a bar $1\frac{1}{4}$ inch square.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
$\frac{1}{8}$ in.	8757 8145 (*a*)	18882(*b*)	30461(*c*)			
$\frac{1}{4}$ do.	6658 7103 Mean 6880(*d*)	14850 17538 Mean 16194	25169(*e*)			
$\frac{3}{8}$ do.	6658 6468 Mean 6563	13282	25169			
$\frac{1}{2}$ do.	6405 6405 Mean 6405	13282	23797 24189 23993 Mean 23993		25365 26149 Mean 25757	27788
$\frac{5}{8}$ do.	6341 6278 Mean 6309	13730		38671		
$\frac{3}{4}$ do.		15522 15662 Mean 15592	21522	35888	23797	
$\frac{7}{8}$ do.				35888		
1 do.		15564	21053 21053 Mean 21053			24764
$1\frac{1}{4}$ do.			23869			
$1\frac{1}{2}$ do.		14584	23053			
2 do.		13800	21828			

(*a*) not crumbled, flattened; (*b*) flattened and cracked round the edges; (*c*) reduced in thickness to about half, and cracked round the edges; (*d*) crushed; (*e*) reduced and cracked round the edges.

In all cases where the crushing weight is given without any remark, we may conceive the fracture to have taken place by a wedge sliding off from one of the ends, having the whole end for its base. The rectangles in the last column broke differently, a wedge nearly equilateral formed at the top and bottom which split the sides; the face of the rectangles being divided diagonally.

TABLE 2nd.—COLD BLAST.

Height of Specimens.	Cylinders ¼ inch diameter. Crushing weight.		Cylinders ⅜ inch diameter. Crushing weight.	Cylinders ½ inch diameter. Crushing weight.		Right prisms, base an equilateral Triangle, circumscribing a ½ in. cylinder, its sides being .866 in. Crushing weight.	Right prisms, base a square, ½ inch the side. Crushing weight.		Right prisms, base a rectangle 1.00×.243 inch.
	lbs.		lbs.	lbs.		lbs.	lbs.		lbs.
¼ in.	6738 6774	Mean 6756	17034(*a*)	28798(*b*)					
⅜ do.			14190	27230(*c*) 26838	Mean 27034				
½ do.	6197 6197	Mean 6197	13994(*e*)	24388 24682	Mean 24535	35548(*d*)	27042 24780 *25270	Mean 25697	26587
⅝ do.			14582						
¾ do.	5908 6053	Mean 5980	13994	24486 24388	Mean 24437	33448	24780 *23996	Mean 24388	26587
1 do.	5764 5836(*g*)	Mean 5798	14190	24780 24584	Mean 24682	31348(*f*)	24296 *23604	Mean 23950	25538
1¼ do.			14190	24486					
1½ do.			13702(*h*)	23604(*i*) 23702	Mean 23652				

(*a.*) With this weight the specimen was flattened in the middle and crushed round the edges.

(*b.*) The specimen was reduced in thickness to 1-10 of an inch, and broken round the edges.

(*c.*) Crushed except the centre.

(*d.*) Fracture, a pyramid, splitting the three sides, one base whole, and the vertex of this base shown in the other.

(*e.*) Bulged out in the middle before breaking.

(*f.*) Fracture by the ends forming the bases of pyramids meeting in the centre and throwing out the corners. See drawing.

(*g.*) Specimen slightly bent; wedge .46 inch long.

(*h.*) Pillar bent a little, cracked across the middle; no alteration previous to fracture.

(*i.*) Bent a little with about a ton less than what broke it.

The specimens in the first column were turned out of a bolt ⅝ inch diameter. All the specimens in the last three columns were out of the centre of a bar 1¼ inch square, except those marked *, which were from the middle of an inch bar. The wedges broken off from three of the longest cylinders ⅜ inch diameter measured in length .56, .50, .52 inch respectively. Two wedges from the ½ inch cylinders, 1 inch high, measured .68 and .65 inch in length.

By comparing the results in the two preceding tables, it will be seen that, where the length is not more than about three times the diameter, the strength for a given base is pretty nearly the same, as has been shown by Mr. Rennie and others. In that case, the prism, in cast iron at least, either does not bend before fracture, or bends very slightly, and therefore the fracture takes place by the two ends of the specimen forming cones or pyramids, which split the sides and throw them out; or, as is more generally the case in cylinders, by a wedge sliding off, starting at one of the ends, and having the whole end for its base, as has been before mentioned; this wedge being at an angle dependent upon the nature of the material. In cast iron this angle is, as will be seen further on, such that the height is somewhat less than $\frac{3}{2}$ of the diameter; if the height of the specimen is less than the length of the wedge, the resistance is somewhat increased, and if the height be greater than from three to four times the diameter, the resistance, on account of the flexure of the specimen, will be decreased. In estimating the strength of the iron from the above table, I shall mostly confine myself to such specimens as vary from about the length of the wedge to twice its length, avoiding such results as are reduced by flexure. Taking then the results from the cylinders and prisms of different dimensions of base, giving the means, with the number of experiments from which they were taken, we have the following abstracts:

FROM TABLE 1.—HOT BLAST.

Diameter of cylinder.	Number of experiments.	Mean crushing weight	Mean crushing weight per sq. inch.	General mean per square inch.
		lbs.	lbs.	
$\frac{1}{4}$	3	6,426	130,909	121,685 lbs.= 54 tons 6½ cwt.
$\frac{3}{8}$	4	14,542	131,665	
$\frac{1}{2}$	5	22,110	112,605	
$\frac{16}{25} = .64$	1	35,888	111,560	
Prism, base .50 inch square.	3	25,104	100,416	100,738 lbs.= 44 tons 19½ cwt.
do. base 1.00 × .26	2	26,276	101,062	

FROM TABLE II.—COLD BLAST.

Diameter of cylinder in parts of an inch.	Number of experiments.	Mean crushing weight.	Mean crushing weight per sq. inch.	General mean per inch
		lbs.	lbs.	
$\frac{1}{4}$	2	6,088	124,023	125,403 lbs.=55 tons 19½ cwt.
$\frac{3}{8}$	4	14,190	128,478	
$\frac{1}{2}$	7	24,290	123,708	
Equilateral triangle side .866.	2	32,398	99,769	100,631 lbs.=44 tons 18½ cwt.
Squares, ½ inch the side.	2	24,538	98,152	
Rectangles, base 1.00 × .243.	3	26,237	107,971	
Cylinders .45 inch diameter and .75 high (not in table.)	2	15,369	96,634	

The prisms, whose bases were triangles, squares, rectangles, and the cylinders last mentioned, were all cut out of the centre of a bar 1¼ inch square.

It will be noticed that the cylinders in both the tables give much higher results per square inch than we have just found from the specimens cut out of the $1\frac{1}{4}$ inch bar. This the writer is inclined to attribute to no other cause but that they were mostly turned out of small cylinders cast for the purpose, which caused them to be harder than those from the middle of a larger mass.

We will defer speaking of such comparative results as affect the general question of hot and cold blast iron, till all the evidence is obtained which the present paper will afford; drawing, however, as we proceed, such other conclusions as seem to be made out from the experiments.

Taking the mean crushing weight per square inch, as just obtained in the abstracts from the different cylinders in the 1st and 2nd tables, and retaining only the three first figures, we have

From 1st table, diameter $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{16}{25}$ } Strength } 131, 132, 115, 112.
From 2nd do. $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$ } per inch. } 124, 128, 124.

The strengths per square inch in each of these lines approach to an equality, particularly in the latter, where the areas of section vary as 1:4; and the strength per inch is in both cases represented by 124. In the former line the cylinders of $\frac{1}{4}$ and $\frac{16}{25}$ inch diameter give strengths varying as 131 to 112 per square inch. The areas here vary nearly as 1:6.5, and the falling off in strength is about one-sixth. This small diminution in the power of the larger cylinders to resist crushing, may be accounted for from those having been cut out of a larger body of metal than the small ones; a matter which we have seen greatly reduces the strength.

Admitting, then, that the strength per square inch in each of the preceding cases would have been the same if the iron had always been of equal hardness, we must conclude that "the resistance of short cylinders of cast iron to a crushing force is directly as the area."*

If we refer to the abstract from tables 1 and 2 for the mean strengths per square inch, as given by the equilateral triangle, the square, the rectangle, and the cylinder, we shall find them

In the latter, 99,769. 98,152. 107,971. 96,364;
In the former, 100,416. 101,062.

The strength, 107,971 and 101,062, as given by the prisms whose base is a rectangle, is the greatest;† and this may be accounted for from their superior breadth to that of the other specimens, and consequently, from their having in them more of the outside and harder part of the bar, out of which they were cut, than the others. In the other forms the difference of

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* Conceiving it desirable that this matter should be left without a doubt, and as Mr. Fairbairn had some very good teakwood which had been many years in store, 12 cylinders were turned whose diameters were $\frac{1}{2}$ inch, 1 inch, and 2 inches, 4 of each; the latter 8 out of the same piece of wood; the height in each case was double the diameter; the strengths were as below.

Cylinders $\frac{1}{2}$ inch dia.		Cylinders 1 inch dia.		Cylinders 2 inches dia.	
2335	Mean 2439	10507	Mean 10171	38909	Mean 40304
2543		9499		39721	
2543		10507		41294	
2335		10171		41294	

These quantities, taking the means, are nearly as 25,100 and 400, which is the ratio of the areas, and therefore the strength is nearly as the area, though this varies as 4 and 16 to 1.

† Rondelet (*Traité de l'Art de bâtir*, book ix, page 150) found that prisms of stone, whose base was a rectangle, as above, bore somewhat *less* than those with square bases of the same area.

strength is but little; and therefore we may perhaps admit that "difference of form of section has no influence upon the power of a short prism to bear a crushing force."

Mode of Fracture. See Plate 1.—When a rigid body is broken by a crushing force, which is prevented from acting after it has effected a rupture, it will be found not to be crumbled or reduced to a shapeless mass, but to be divided according to mathematical laws, and sometimes into very interesting forms of fracture. The accompanying plate will show how the fracture was effected in a variety of cases, and that these were all subject to one pervading law. The figures in the plate are of the same size as the specimens. Fig. 1 represents a cylinder before it was crushed; fig. 2 represents a wedge broken off from the same cylinder, the point of the wedge being flattened by the crushing apparatus after the fracture. There is a small crack in this wedge indicating a disposition to slide off in another direction, or rather to form a double wedge, nearly equilateral, having the diameter of the end of the cylinder for its base, and its height about half that of the former. The operation of this double wedge would be to split the cylinder and throw out its two sides. Figs. 3 and 4 represent another cylinder before and after crushing; in fig, 4, a double wedge formed at each end threw out the opposite sides. Figs. 5 and 6 represent a cylinder before and after crushing; in the latter, as in fig. 4, the ends of the figure have formed the bases of imperfectly formed cones, whose tendency has been to separate the sides. Fig. 7 is intended to represent one of these cones, the vertex of which is a sharp edge or point. Fig. 8 represents another cylinder of rather soft iron; the pressure was removed in the commencement of the fracture, and the circumference was found to be surrounded with parallel cracks both ways; the angle of these cracks with the base being that of the usual inclination of the wedge. Fig. 9 represents the appearance of a very short cylinder after fracture; the vertex of the cone, formed upon the end not shown, has split the end here represented, leaving a part in the middle unbroken; the opposite end is sound for a much greater central area than this, but its edges are a little broken.

Fig. 10 represents a rectangle;* and fig. 11 its appearance after fracture. One end of the specimen has been formed into a pyramid *a*, sharp pointed at *d*, which has split the opposite base and thrown off the end *b*, and the part *c* very nearly. The sides and angular piece at the end are lost.

Fig. 12 represents a short rectangle before crushing; figs. 13, 14, 15, the different appearance of specimens of the same size after fracture. In fig. 14 the fracture has been caused by a sliding off in the way of the diagonal; in fig. 15 the specimen slided off in the direction *b c*, as before, and was cracked through its whole length in the direction *a d*; in fig. 13, the top of the specimen formed the base of a wedge which had split the bottom, and the bottom itself had formed the base of a wedge. Fig. 16 represents a rectangle of the same base as the preceding, but of double the height. Figs. 17, 18, 19, 20, represent its appearances as shown by different specimens after fracture. Fig. 20, in which the parts are separated, shows a wedge *a c d*, which has for its base the bottom of the prism; this wedge has, commencing its vertex *c*, a sharp line *c d*, $\frac{1}{4}$ inch long; and by the operation of its sides, the wedge has removed the parts *e* and *f*, and separated the sides *g* and *h*, which before jointed together at the top and formed part of the upper side of the prism. The part *a b*, adhering to the lower part of the wedge, and which had formed part of the side of the prism, was nearly separated by the action of another wedge formed by the lower end of the part *g*, which formed a wedge not represented by the figure, but whose vertex formed a sharp line about .43 inch long in the direction *i k*. This wedge occupied the space between *b* and *c d*, and its tendency was to split off from the principal wedge the only remaining portion *a b*.

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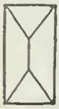
* The prism is, in this and many other places, designated by the form of its base.

Fig. 21 represents a prism of the form of an equilateral triangle, and fig. 22 is its appearance after fracture. The tendency is here, as before, for opposite wedges to be formed, which split off the angles and separate the sides. Figs. 23, 24, 25, give direct representations of the three sides.

Angle of Wedge.—We have seen that when bodies are subjected to a crushing force, their fracture, if they do not break by bending, is caused by the operation of a cone or wedge, which seems, under various circumstances, to slide off at nearly a constant angle. If a prismatic body, as for instance, a short cylinder, be subjected to a crushing force, there seems no reason why fracture should take place one way more than another; there is usually too in soft irons a bulging out in every direction round the cylinder, which shows that it is equally strained all round: a matter which is otherwise exemplified in fig. 8. If then the cylinder be longer than the wedge, or than the two cones which are always in operation at the ends during crushing, it is evident that the angle of the wedge and cones, which is the same, will depend upon the nature of the material, and the cones must be isosceles. Cylinders longer than the wedge usually slide off in one direction without showing the cones, but some examples in other forms have been obtained; as for instance, in the fracture of a rectangular specimen whose base was 1.00×.26, and its height .50 inch (Table I.) the rupture took place by wedges, which appeared to be isosceles, being formed at the top and bottom of the ends of the specimen, and dividing the sides in the middle, as in the annexed figure.



In cases however where the height of the specimen was not equal to that of the two opposing or double wedges, then these cones and wedges could not be isosceles after fracture commenced. It is shown by several of the figures (figs. 4, 6, 11, 13, 20, &c.) how fracture takes place, and that in such cases the wedges do not meet directly and crush their opponents, but have sharp points and slip past each other to effect the destruction of the piece of which they are formed. It is evident therefore that the angles, which the sides of these wedges make with their base, cannot in this case be equal; this is shown by the rectangles one inch high, and it was found to exist in a higher degree in the fracture of those of half the height. In these the angle with the base was further reduced, through an almost necessary tendency of the specimen to divide itself in the diagonal; though the angle there was less, on account of the compression of the prism, than the natural angle in this material. The angle of the wedge as obtained from different specimens is as follows:

Cylinders.

Carron Iron, No. 2, 54° 15′, 54° 15′, 52° 10′, 59°, 56° 15′	Mean 55° 11′
Buffery Iron, No. 1, 58°, 54°, 56°, 58°, 56°, 62°, 56°	Do. 57° 8′
Coed-Talon, No. 2, 55°, 56°, 56°, 53½°, 53°, 49°	Do. 53° 40′
Mean angles from cones 56½°, 54½°, 57½°	Do. 56° 10′
Mean from the whole, being 21 cylinders of various lengths,	55° 32′

Rectangular prisms 1 inch high, Carron Iron, No. 3, angles made by the sides of the double wedge, with the base.

Cold Blast	54° 58			Mean 56° 48′
Hot Blast	58½ 57	55½° 60	53°	
	54½° 60			

Rectangular prisms ½ inch high, Carron Iron, 48°, 51°, 52°, 54°, 57°, 52°, Mean 52° 40′

Mean angle from the above rectangular prisms 54° 41′

Prisms, Base .50 × .50 *inch.*

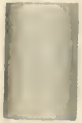
Carron Iron, No. 2 53°, 54° Mean 53° 30′

From the preceding examination of the angles obtained from specimens of different forms and lengths, it appears that amidst great anomalies, there is, taking the *mean* results, a considerable approach to equality, as is more particularly shown from the angles of the cylinders and rectangular prisms; and this approach would doubtless have been greater and the anomalies less if the specimens had always been longer than the wedge. The defect in the angle from this cause is evident in the shorter rectangular prisms, and has been alluded to before.

We may assume therefore, without assignable error, that in the crushing of short cast iron prisms of various forms, longer than the wedge, the angle of fracture will be the same. This simple assumption, if admitted, would prove at once, not only in this material but in others, which break in the same manner, the proportionality of the crushing force in different forms to the area; since the area of fracture would always be equal to the direct transverse area multiplied by a constant quantity dependent upon the material.

The preceding experiments on crushing have been confined to one sort of iron, the Carron No. 2, hot and cold blast. The results from other irons are given in the following table:—

Fig. 1



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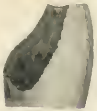

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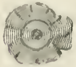

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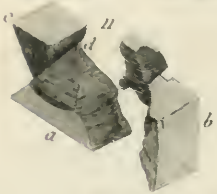

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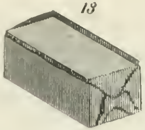

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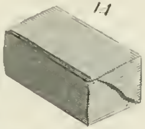

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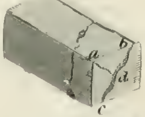

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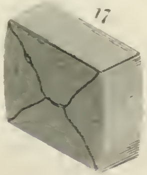

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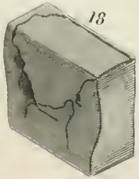

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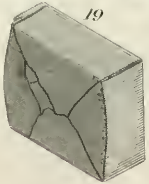

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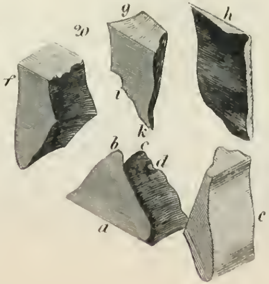

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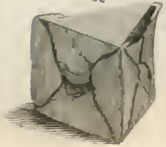

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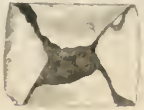

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COMPRESSION.—TABLE, No. III.

Result of Experiments to ascertain the forces necessary to crush short cylinders, &c. of cast iron, from various parts of the United Kingdom. All the cylinders were turned out of bars cast 1 inch square, and the rectangular prisms were cut out of the castings broken in the experiments on tension.

Devon (Scotch) Iron, No. 3. Hot Blast.

Height of specimen.	Cylinder Diameter .505 inch.	Cylinder Diameter .380 inch.
	Crushing weight in lbs.	Crushing weight in lbs.
¾ inch.	31,138	15,323
1 "	30,438	15,789
Mean from above	30,788	15,556
Mean per square inch.	153710	137160
Mean per sq inch from the whole.	145,435 lbs. = Tons. 64	Cwts. 18½

Buffery (near Birmingham) Iron, No 1.

	Height of specimens.	Crushing weight in lbs.	Mean crushing weight per square inch in lbs.
Hot Blast. Diameter of cylinder .505 inch.	½ inch.	17,823	
	1 "	17,039	
	1½ "	17,431	
	2 "	16,927	
	Mean	17,305	86,397 = Ton Cwt 38 11¼
Cold Blast. Diameter of cylinder .506 ich.	½ inch.	18,271	
	1 "	18,943	
	1½ "	19,615	
	2 "	18,271	
	Mean	18,775	93,385 = Ton Cwt 41 13½

Coed-Talon (Welsh) Iron, No. 2.

	Height of specimens.	Crushing weight in lbs.	Mean crushing weight in lbs. per square inch.
Hot Blast. Diameter of cylinder .6075 inch.	½ inch.	25,541	
	1 "	24,278	
	1½ "	23,228	
	2 "	22,878	
	Mean	23,981	82,734 = Ton Cwt 36 18½
Cold Blast. Diameter of cylinder .6025 inch.	½ inch.	24,978	
	1 "	22.528	
	1½ "	22,878	
	2 "	22,878	
	Mean	23,313	81,770 = Ton Cwt 36 10

Carron (Scotch) Iron, No. 2. Right Prisms, area of base $\frac{3}{4}\times\frac{1}{3}=\frac{1}{4}$ inch.

	Height of specimens.	Crushing weight in lbs.	Mean crushing weight in lbs. per square inch.
Hot Blast.	.50	27,541	
	1.00	26,729	
	Mean	27,135	108,540 Ton Cwt =48 9
Cold Blast.	.50	28,353	
	1.00	25,511	
	1.00	25,917	
	Mean	26,593	106,375 Ton Cwt =47 9¾

Carron (Scotch) Iron, No 3. Right Prisms, area of base $\frac{3}{4}\times\frac{1}{3}=\frac{1}{4}$ inch.

	Height of specimens.	Crushing weight in lbs.	Mean crushing weight in lbs. per square inch.
Hot Blast.	.50	34,037	
	.75	33,631	
	1.00	32,413	
	Mean	33,360	133,440 Ton Cwt =59 11¼
Cold Blast.	.50	29,165	
	.50	29,571	
	1.00	27,541	
	1.00	29,165	
	Mean	28,860	115,442 Ton Cwt =51 10¾

Ratio of Tensile to compressive forces in Cast Iron.

Having obtained the forces per square inch necessary to tear asunder and to crush masses of cast iron of the kinds previously enumerated, we will seek for the ratio of these forces, taking the breaking weights from the preceding table and that on tension.

Description of metal.	Compressive force per square inch.	Tensile force per square inch.	Ratio.
Devon Iron, No. 3. Hot Blast.	145,435	21,907	6.638:1
Buffery Iron, No. 1. Hot Blast.	86,397	13,434	6.431:1
do. No. 1. Cold Blast.	93,385	17,466	5.346:1
Coed-Talon Iron, No. 2. Hot Blast.	82,734	16,676	4.961:1
do. " Cold Blast.	81,770	18,855	4.337:1
Carron Iron, No. 2. Hot Blast.	108,540	13,505	8.037:1
do. " Cold Blast.	106,375	16,683	6.376:1
Carron Iron, No. 3. Hot Blast.	133,440	17,755	7.515:1
do. " Cold Blast.	115,442	14,200	8.129:1

Before quitting the subject of compression, I may mention that, in experiments upon various bodies besides cast iron, a tendency to form cones or pyramids in the fracture was observable, showing that the same laws were in operation in these as have been developed in the experiments upon cast iron. For instance, in the crushing of short cylinders of bone obtained from the thigh of an ox, fracture always took place by cones or wedges. In marble the same result was frequently observable, though less obvious than in iron, through a disposition to split in the direction of the strata.

On the power of timber of various kinds to resist a crushing force, I have, through the liberal views of Mr. Fairbairn, made a considerable number of experiments, with an apparatus similar to that employed in the crushing of cast iron, but much larger. In this material, though fibrous, fracture always took place by wedges sliding off, or by cones or wedges splitting the prism in the manner of cast iron, though at a much less angle with the horizon than in that metal. In the crushing of malleable iron likewise, short specimens always bulge out in the middle through the operation of the opposing cones or pyramids formed at their bases.

As this principle is found to obtain in the crushing of short bodies so widely different as bones, marble,* timber of all kinds, cast iron, malleable iron, we may therefore assume that it is in operation in the crushing of all rigid bodies, and consequently that, in any particular one, the resistance will be as the area of its section.

I may perhaps mention that this subject ought to be studied in conjunction with optics and crystallization. The singular structure of the mineral called analcime, or cubizite, as shown by polarized light, and given by Sir David Brewster, Optics, chap. xxv., has so much the appearance of some of our fractures, as to lead one to conceive that it may have arisen from compression.

(TO BE CONTINUED.)

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* Rondelet (*Traité de l'Art de bâtir*) crushed stones of various kinds, and has given the forms of pyramids obtained from crushing prisms with square bases.

An account of the recent Progress and Present extent of Manufactures in Prussia, and of the Trade of the Prussian Commercial Union in Manufactured Goods. From German Official Documents. By R. W. Rawson, Esq., *read before the Statistical Society, London.*

It is chiefly the competition of Germany and Switzerland that our manufacturers profess to fear; and it is in those countries that the greatest impulse has recently been given to native industry. Switzerland, with its limited means and local disadvantages, situated at so great a distance from any sea or débouché for its products, is nevertheless able to compete, in distant lands, as well with the fabrics of Great Britain as with the finest wares of France. Germany, on the other hand, particularly those parts in which manufactures are chiefly carried on, is more favourably situated. Eastern Prussia possesses numerous ports on an accessible and much frequented sea. Saxony has an easy outlet by means of the Elbe; and the Rhenish provinces of Prussia are equally favoured by their proximity to the Rhine. Under a system of free interchange, our commercial relations with Prussia might have been very extensive. Her fields produce many articles of primary importance to us,—corn, timber, flax, hemp, &c.; while we have the means of supplying her with the produce of our colonies and of our looms. A few years ago, there were scarcely any two countries more favourably situated for commercial intercourse; but we declined receiving her produce, and there was no other country in want of it; she had, therefore, no foreign market for the surplus of her agriculture, and her means of internal consumption were proportionally crippled. Still an increasing population must be clothed, but they had no means of paying the foreigner for his stuffs: they must find a means of livelihood, but agriculture no longer adequately afforded it; hence the peasants had recourse to manufactures. A system of domestic manufacture continued for a long period, and prevails to a great extent even at the present time, chiefly in the weaving of flax and sheep's wool; for it has not been applied to that of silk, and only very partially to that of cotton. But of late years, the introduction of machinery, and the erection of large establishments upon the same extensive system adopted in this country, have carried the production far beyond the demand for home consumption, and Prussia and Saxony at present export annually a large quantity of manufactured stuffs. It is of less consequence to British interests to trace the early progress of manufactures in these countries, than to show their advance during a recent period; for this purpose a comparison is made of their condition in 1831 and 1837.—Weaving, and the preparation of yarn for the use of the looms, are the most important branches of manufacturing industry in Prussia. In general, spinning by hand is so light an employment, that it may be pursued by persons of almost any age; and it has this additional advantage, that it may, at any moment, be interrupted without injury, and resumed at pleasure. It is, therefore, well adapted for an occasional occupation, during the intervals of other labours. Weaving requires greater skill, practice, and bodily strength; but the amount for the manufacturing of plain cloths, is so small, that weaving also may be carried on to a considerable extent as an occasional employment. Agricultural families frequently weave in the spring the yarn which they have spun during the winter. The facilities which attend these two branches of labour have led to their extensive adoption throughout the whole of Prussia. Large quantities of linen and woollen yarn are annually produced by hand; and, in 1837, there were no less than 246,294 looms occasionally employed in the manufacture of linen. Flax is by far the cheapest of the materials used in weaving, but the yarn made from it is dearer than that of cotton, because it is still chiefly made by hand. Whenever the progress of mechanics and chemistry shall render it possible to spin flax of equal fineness and at the same cost as cotton, without any great injury to its tenacity (in which consists the excellence of linen yarn,) a great revolution must take place in the agricultural, manufacturing, and commercial relations of Prussia.

Weaving is almost entirely confined in Prussia to four materials—flax, cotton, sheep's wool, and silk. According to the accounts made up to the end of the year 1837, there were, in the whole of the Prussian States, 152 establishments for spinning cotton, which contained 125,972 spindles. In the kingdom of Saxony, at the same period, there were 107 similar establishments, containing 370,805 spindles, making a total of 496,777, or nearly half a million in the two countries. So that the power of manufacturing twist in Prussia and Saxony, in 1837, was less than 1-19th, or 5⅓ per cent. of what it was in the United Kingdom in 1833, and 2-5ths of what it was in the United States in 1831. But Prussia, and the States within the Prussian Commercial Union, import annually a large quantity of cotton twist, chiefly from Great Britain. The quantities of raw cotton imported into, and exported from the Union, were, in—

	Imports. lb.	Exports. lb.	Excess of imports. lb.
1835	14,285,397	3,665,532	10,619,865
1836	22,176,407	4,190,023	17,986,384

The excess of importation of raw cotton over the exportation, has increased 70 per cent. in the year 1836, compared with the preceding year; and 11-12ths of the imports were brought into Prussia. The trade of the Union in this article was as follows in 1835 and 1836:

		Imports. lb.	Exports. lb.	Excess of Imports. lb.
White single twist	1835	28,906,000	3,413,909	25,493,000
	1836	36,343,000	3,298,000	33,045,000
Double twist	1835	764,000	1,352,000	588,000
	1836	1,085,000	1,399,000	314,000

The excess of import, therefore, of single twist had increased 30 per cent., and the excess of export of double twist had decreased 46 per cent. in the latter year. Although the principal portion of the cotton twist used in Prussia is imported from Great Britain, there are 40 spinning establishments in the Rhenish provinces, containing 98,347 spindles.

Woollen yarn is partly spun in large establishments, but principally by small machines of 40 spindles; still the spinning of wool by hand has by no means ceased in Prussia, although it has become so unprofitable that it must of necessity be relinquished as the manufacture by machinery increases. Prussia is chiefly supplied with wool from her own flocks; some foreign wool is annually imported, but a much larger quantity of native growth is exported. The number of sheep in the whole kingdom in the year 1834, was 12,632,277. The number in 1831 was 11,751,603; the increase, therefore, in the three years, was 7½ per cent. But this increase was proportionally much greater in the superior breeds of sheep, as will appear from the following statement:—

	Merinos and whole-bred Sheep.	Half-bred Sheep.	Common Sheep.
In 1831	2,397,171	5,301,385	4,053,047
1834	2,831,553	5,839,332	3,961,392
Increase	434,382	537,947	
Decrease			91,655

Thus the best sheep had increased more than a fifth, and the middling sheep a tenth, while the number of common sheep had fallen off more than 2 per cent. As it is reckoned that the best sheep yield annually 3 Prussian pounds of wool, the middling 2½ lb., and the common 2 lb., it is obvious that the production of wool had greatly increased during the above period. M. Ferber, who wrote upon the commerce of Prussia in 1832, estimates the average produce of wool at one stone of 22 lb. Prussia, or 23 3·5 lb. English to 10 sheep. Upon this calculation the total produce, in 1831, amounted to 27,745,248 lb. English; and, in 1834, to 29,824,497 lb., showing an increase of 2,079,249 lb., or 7½ per cent. In order to exhibit the actual consumption of the country, there must be deducted from the above quantities the difference between the quantities of foreign wool exported, and those imported during the same years, which were as follows:—

	Imports.	Exports.	Excess of Exports.
In 1831	3,936,808 lb.	8,316,772 lb.	4,379,964 lb.
1834	6,592,140	12,246,777	4,654,637

There remained, therefore, for home consumption in 1831, 23,365.284 lb.; and, in 1834, 24,169,860 lb. The wool imported is of a coarse kind, and chiefly brought from Poland. That exported consists principally of fine wool, which is shipped at Hamburgh for England.

The number of machines for spinning woollen and worsted yarn in Prussia, at the close of the year 1837, was 4,143, containing 401,210 spindles. The number of flax spinning factories was 7, containing 10,444 spindles. It appears that there were 6 similar establishments in Saxony at the same period. The extensive linen manufacture of these two countries is chiefly supplied with yarn spun by hand; and it is this employment which affords occasional occupation to a very large portion of the population both in the towns and rural districts. A large quantity of yarn, however, is imported from abroad, and the export, which was formerly considerable, is annually falling off. In 1836 the imports exceeded the exports by 2,166,785 lb. of raw, and 611,203 lb. of prepared yarn. Notwithstanding that flax is cultivated very extensively throughout Prussia, the quantities imported have generally exceeded those exported. The year 1836 was an exception; but in the five preceding years the imports, on the average, exceeded the exports by one-third. The Prussian customs' accounts do not distinguish the imports of raw silk; Ferber, in 1832, estimated the annual importation at from 670,000 to 700,000 lb. In 1837 the number of persons engaged in its production was 256, and the whole produce may be estimated at 2,150 lb. The quantity of dyed, bleached, and thrown silk imported into the Union, 1836, was 131,688 lb., and the quantity exported was 76,259 lb.

The following table will show the quantities of linen manufactures imported into, and exported from, the states comprising the Prussian Commercial union in each of the three years, ending with 1836. The rates of duty on importation were, and continue to be—

	s.	*d.*	
Upon grey packing linen, or sail cloth	1	10	per cwt.
Raw unfinished linen cloth and ticking	5	7	"
Bleached, died, or printed linen cloth or ticking, table-linen, and towelling, &c.	30	8	"
Ribbons, cambric, Batist, tape, hosiery, &c.	61	4	"
Lace thread	153	4	"

There is no duty on exportation.

Description.	Years.	Import.	Export.	Excess of Export.
		lb.	lb.	lb.
Grey packing linen and sailcloth	1834	739,575	3,774,963	3,035,388
	1835	726,826	3,629,882	2,903,056
	1836	969,770	6,013,759	5,043,989
Raw unfinished linen cloth and ticking	1834	663,316	1,777,696	1,114,380
	1835	581,980	2,431,450	1,849,470
	1836	2,277,161	3,354,710	1,072,549
Bleached, dyed, or printed linen cloth and ticking, table-linen, and towelling, &c.	1834	96,913	12,007,922	11,911,004
	1835	99,633	12,553,425	12,453,792
	1836	151,102	12,949,597	12,798,496
Ribbons, cambric, Batist, tape, hosiery, &c.	1834	10,860	749,255	738,395
	1835	15,582	789,864	774,282
	1836	12,277	1,103,992	1,091,715
Lace thread	1834	2,833	6,020	3,187
	1835	2,479	5,666	3,187
	1836	2,243	6,610	4,367

The manufacture of woollens is much less extensive in Prussia than that of linen, but it is increasing. Prussia and the other states of the Commercial Union export a large quantity of woollen manufactures. The following is the amount of trade of the whole union in woollens during each of the three years ending with 1836:—

		Imports.	Exports.	Excess of Exports.
		lb.	lb.	lb.
Woollen cloths, stuffs, and hosiery,	1834	1,393,329	6,040,910	4,647,580
	1835	1,620,337	7,119,557	5,492,219
	1836	1,450,465	7,948,814	6,498,349
Carpets of sheeps and other wool	1834	19,596	56,781	37,185
	1835	20,304	67,405	47,101
	1836	25,144	72,600	47,455

From this statement it appears that the excess of exportation of woollen goods, exclusive of carpets, has increased 18 per cent. in each of the last two years above quoted.

The total cotton manufacture has nearly doubled since 1825. The number of looms at work in the whole kingdom, were—

1825	22,139
1834	31,759
1837	39,798

The following table exhibits the imports and exports of cotton goods in the Prussian dominions alone, upon an average of the three years, 1829 to

1831. Of the Prusso-Hessian league, consisting of Prussia and the two Hesses, in the year 1832 and 1833, and of the whole union, in the three following years:—

	Imports. lb.	Exports. lb.	Excess of Exports. lb.
Average of 1829-31	1,434,292	2,174,694	740,402
1832	1,671,452	3,055,574	1,384.122
1833	1,529,085	2,753,369	1,224,281
1834	1,598,380	8,848,346	7,249,966
1835	1,630,017	9,590,873	7,960,856
1836	1,594,484	9,948,324	8,353,840

Thus throughout the whole period the importations have remained nearly stationary. The exports increased to some extent in 1832 and 1833. In 1834, they rose in the proportion of 3 to 1 compared with the average of 1832-33, and of 4 to 1 compared with 1829-31.

The increase of the silk manufacture has been very rapid since 1831. The number of looms employed in the fabrication of silk and half-silk goods was—

	No. of Looms.
1831	8,956
1834	12,044
1837	14,111

The following is a statement of the imports and exports of silk and mixed silk manufactured goods from and into the Prussian Commercial Union, in the years from 1834 to 1836:—

	Silk Goods.			Mixed Silk Goods.		
	Imports.	Exports.	Excess of Exports.	Imports.	Exports.	Excess of Exports.
	lb.	lb.	lb.	lb.	lb.	lb.
1834	254,985	559,079	304,094	106,950	320,266	213,316
1835	201,981	762,004	560,023	106,596	371,971	265,375
1836	225,581	847,826	622,245	121,236	404,435	283,189

The total value of silk and mixed silk manufactures exported from the Prussian Union in 1836 is estimated at 2,726,300*l*., of which 2,119,500*l*., or more than three-fourths, consisted of silk, and 606,500*l*. of mixed silk goods. The imports in the same year amounted to 745,000*l*. Knitting by hand, which is carried on among the labouring population as an occasional employment, and among the wealthier classes as an amusement, continues to supply a great part of the hoisery required, at so cheap a rate that no machinery can compete with it. The shearing and finishing of woollen cloths, furnished employment at the close of 1837 to 3,480 persons. No information has been collected respecting the bleaching of linen and cotton goods, or the establishments for dyeing raw silk. The number of persons employed in other kinds of dyeing amounted, in 1837, to 7,239, of whom 3,387 were masters, and 3,852 apprentices. This number includes only the operatives skilled in this process, and not the day-labourers, who are employed in mere manual labour connected with it.

Athenæum of Science and Arts.

Observations on the application of Heliographic or Photogenic Drawing to Botanical Purposes; with an account of an economic mode of preparing the Paper: in a Letter to the Editor of the 'Magazine of Natural History.' By Golding Bird, M.D., F.L.S., &c.

Sir,—The mode of fixing the images of the camera obscura, and copying engravings, by means of the chemical action of light on paper prepared with a solution of chloride of silver, has attracted so much notice, and produced so much popular excitement, that a few observations on this interesting process will not perhaps be considered out of place in your Magazine. I venture to occupy your pages with the less reluctance, because I feel that the application of this heliographic or photogenic art will be of immense service to the botanist, by enabling him to procure beautiful outline drawings of many plants, with a degree of accuracy which, otherwise, he could not hope to obtain.

That light will act on chloride of silver is by no means a novel discovery, and paper prepared with it was long ago used by Ritter and Wollaston, in testing the chemical action of the rays of the solar spectrum; still, in this country it was not, I believe, applied to any purpose likely to be of use to the naturalist and traveller, until brought into notice by the researches of Mr. Talbot. It is not a little amusing to observe how many pretenders to the discovery have started up since the announcement of Mr. Talbot's discovery, and that of M. Daguerre in France. The latter gentleman has, through M. Arago, at a late meeting of the French Institute, announced his mode of preparing a sensitive paper, far exceeding that of Mr. Talbot in delicacy, but otherwise possessing the same property of indicating intensity of light by depth of colour, and consequently differing from that marvellous preparation which he is said to possess, and which represents shadows by depth of colour, precisely as in nature.

M. Daguerre prepares his heliographic paper by immersing a sheet of thin paper in hydrochloric ether, which has been kept sufficiently long to be acid; the paper is then carefully and completely dried, as this is stated to be essential to its proper preparation. The paper is next dipped into a solution of nitrate of silver, (the degree of concentration of which is not mentioned,) and dried without artificial heat in a room from which every ray of light is carefully excluded. By this process it acquires a very remarkable facility in being blackened on a very slight exposure to light, even when the latter is by no means intense, indeed by the diffused daylight of early evening in the month of February. This prepared paper rapidly loses its extreme sensitiveness to light, and finally becomes not more readily acted upon by the solar beams than paper dipped in nitrate of silver only. M. Daguerre renders his drawings permanent by dipping them in water, so as to dissolve all the undecomposed salt of silver.

This process is very inconvenient, for many reasons, among which are the difficulty of procuring, as well as the expense of, hydrochloric ether: on this account I prefer Mr. Talbot's process, although it is to be regretted that this gentleman has not stated more explicitly the proportions in which he uses the ingredients employed in the preparation of his sensitive paper. I have performed a set of experiments on this subject, and can recommend the following proportions as the most effective and economical. 200 grains of common salt are to be dissolved in a pint of water, and sheets of thin blue wove post paper saturated with the solution, which, for this purpose, should be poured into a dish, and, the paper being immersed, the application of the solution to every part should be ensured by the use of a sponge. The paper is then to be removed, drained of its superfluous moisture, and nearly dried by pressure between folds of linen or bibulous paper.

240 grains of fused nitrate of silver are then to be dissolved in 12 fluid ounces of water, and this solution is to be applied by means of a sponge to one side of each sheet of the previously prepared paper, which side should be marked with a pencil, so that when the paper is fit for use the prepared side may be distinguished. The sheets of paper are then to be hung upon lines in a dark room to dry, and when nearly free from moisture, their *marked* sides are be once more sponged over with the solution of silver, and finally dried; they are then to be cut into pieces of convenient size, and preserved from light, or even too much exposure to air, by being wrapped up in several folds of brown paper, and kept in a port folio.

The proportions above recommended are sufficient for the preparation of a quire of the kind of paper alluded to; if more of the salt of silver were used, the paper would indeed become darker by the action of light, but its expense would be proportionally increased: and when prepared in the manner directed, it assumes, by less than a minute's exposure to the rays of the sun, a rich mulberry brown tint, of sufficient intensity to define an outline very beautifully, which indeed is all that is required.

To use this paper, the specimen of which a drawing is required, is removed from the herbarium, placed on a piece of the paper, and kept *in situ* by a pane of common glass pressed by weights: a piece of plate glass, however, is preferable, as it is sufficiently heavy to press the plant close to the paper. The whole is then placed in the sunshine, and in less than a minute all the uncovered parts of the paper will resume a rich brown tint. The paper should then be removed from the direct influence of the sun, and placed in a book until the drawing be rendered permanent: the specimen, quite uninjured by the process, may then be replaced in the herbarium, and the drawing of another be taken, and so on. So rapidly is this process executed, that twenty-five or thirty drawings may be obtained in an hour, provided we are favoured with a direct sun-beam; if, however, we have only the diffused day light, five or ten minutes, and sometimes even more, are required to produce a drawing with well-defined outlines.

If drawings of recent plants be required, specimens of proper size should be cut, and if not too rigid, placed on a piece of the paper, and kept in a proper position by means of a pane of glass, as in the case of dried specimens; but if the plant be rigid, the specimens should be placed for twenty-four hours between folds of blotting paper, under a heavy weight, before placing them on the sensitive paper.

Having obtained as many drawings as are required, the next thing is to fix them, so that their otherwise evanescent character may not deprive them of their value. For this purpose place them in a dish, and pour cold water over them; allow them to soak for ten minutes, and then transfer them to, or sponge them over with, a solution, made by dissolving an ounce of common salt in half a pint of water, to which half a fluid ounce of the tincture of the sesqui-chloride of iron has been added. The drawings thus prepared may be dried by pressure between folds of linen, and exposure to the air; and may then be examined without danger. On looking at them every one must be struck with the extreme accuracy with which every scale, nay, every projecting hair, is preserved on the paper; the character and habit of the plant is most beautifully delineated, and if the leaves be not too opake, the venation is most exquisitely represented; (this is particularly the case with the more delicate ferns, as *Polypodium Dryopteris.)* Among those classes of plants which appear to be more fitted than others for representation by this process, may be ranked the ferns, grasses, and umbelliferous plants; the photogenic drawings of the former, are indeed of exquisite beauty.

The fact of the object being white on a brown ground does not affect the utility of this mode of making botanic drawings; indeed I almost fancy that their character is better preserved by this contrast of tint, than by a coloured outline on a white ground. Every one will be fully aware of the value of this process to the botanist, in obtaining drawings of rare plants preserved in the herbaria of others, and which he would otherwise have probably no means of obtaining.

If the drawing of a tree or large shrub be required, a box, blackened inside, having a hole at one end about 1¼ inch in diameter, must be provided; in this hole should be placed a lens of 5 or 6 inches focus; if one of longer focus be used, the dispersion of light becomes too great to ensure an accurate representation. When the tree or shrub is well illuminated by the solar beams, the lens should be presented towards it, at a distance varying of course with the height of the object. A piece of card-board should then be placed in the box, a little beyond the true focus of the lens, and the former moved until a well defined bright image of the tree, &c. is formed on the card, of course in an inverted direction. The box is then to be placed on any convenient support in this position, and a piece of the prepared paper fixed on the card, the lid of the box is then to be closed, and the whole left for half an hour, at the end of which time a beautifully accurate outline of the object will be found on the paper, which is then to be rendered permanent in the usual manner. It is obvious that this plan is unavailable on a windy day, on account of the branches of the tree, &c. being continually moving, so that it is of far less use to the botanist than the above described process for obtaining drawings of small specimens.

Various other applications of this paper will suggest themselves to the minds of naturalists.

Messrs. Herapath and Cox's new process of tanning. By Stephen F. Cox.

Sir,—For some time past I have been working in my tannery upon Messrs. Herapath and Cox's new method of tanning, under license from the patentees, and have much pleasure in bearing testimony to the value of the process, and in corroborating the remarks of your correspondent, Mr. E. Wilkins, tanner, and currier, of Southampton, whose letter, inserted in your valuable Magazine, No. 804, I have read.

I should premise that I am a tanner of butts for sole leather from South American hides; that my accustomed time for the tanning process by the old mode has been twelve months; that my tanning ingredients are English bark and Smyrna valonia, in about equal proportions; and that during the time in which I have been tanning and selling nearly fifteen hundred butts upon the new plan, it has been personally superintended by myself. I do not rely, therefore, upon the dictum of others.

The following is a comparative statement of actual results produced by the new method upon five different lots, amounting to 497, and by the old method upon four lots, amounting to 425, salted Buenos Ayres and Monte Video hides.—See following table.

By this statement it will be seen that the *new process* has produced *in three months 3 4-8 lbs. more leather from a 58 lb. hide,* than is produced by the *old method in twelve months from a 59 1-5 lb. hide.*

These hides were bought in Liverpool by the same agents, were of similar quality, were tanned in the same yard, in the same year, with the same ingredients, *and no stronger liquor was administered to those operated upon by the patent process* than to the others. I have selected the above quantities out of many others, because, both in numbers as whole lots and in their average as hides in their raw state, they approximate nearer, and of course give a more correct comparison, than any others I could take. The time taken to tan those upon the patent mode has varied; some have had *three months tanning*, whilst some have been brought *from the bundled state of salted hide to the market in two months and twenty-one days.*

With respect to colour, I produce what I please, from a dark brown to a straw; but the chief recommendation of sole leather tanned by the patent process is its *impermeable, elastic, and durable qualities;* so that its advantages to the consumer are even greater than to the tanner. I could bring proof upon proof to substantiate this assertion from my numerous customers, for the use of this leather in coal mines, engine manufactories, iron foundries, and public works, as well as from public and private individuals who have long used and tested the leather.

	No. of Hides.	Net payable weights of Hides.			Payable average of Hides.		No. of butts, shoulders and bellies.	Net weights of butts, shoulders, and bellies.			Net average of butts, shoulders, and bellies.	Total weight of leather.			Total weight of leather per Hide.
		cwt	qr	lb.	lb.			cwt	qr	lb.	lb.	cwt	qr	lb.	lb.
New method	497	257	1	15	58	Butts	497	137	0	12	30 7-8				
						Shoulders	497	11	2	27	2 5-8				
						Bellies	994	40	2	25	per pair 9 1-5	189	2	8	42¾
Old method	425	224	2	13	59½	Butts	425	103	0	9	27 1-6				
						Shoulders	425	12	1	10	3 1-4				
						Bellies	850	33	2	25	per pair 8 7-8	149	0	15	39¼

This simple statement of *facts* I leave for the consideration of your readers, and in conclusion beg to observe that I shall be happy to answer any inquiries which may be made of me through the medium of your Magazine in a straight forward and open manner, and as strictly correct as the close attention I have given to the process.

[The following are descriptions of samples which we have received from Mr. Cox, of leather tanned upon Herapath and Cox's patent process, and which we shall be happy to show any parties interested who may call at our office.—Ed. M. M.

No. 1, a piece of shoulder cut from a well-grown Buenos Ayres hide, tanned in three months.

No. 2, a piece of very coarse hide cut from the belly inwards, tanned in ten weeks.

No. 3, a piece of Monte Video hide cut from near the back, of a milder tannage, and softer finish and lighter colour than the two former, tanned in eight weeks.

No. 4, a firm, prime, and bright coloured, piece of Buenos Ayres salted hide cut near the ribs, limed, tanned, *dried, and sent to market, in two months and twenty-one days!*

No. 5, a milder tanned piece of bright coloured leather cut from flank and belly inwards, tanned in seven weeks.

The most impermeable pieces are Nos. 1 and 4. No. 1, although a shoulder, and consequently a loose part, will bear soaking for twenty-four hours without saturation. Mech. Mag.

Mr. Crosley's Pneumatic Telegraph.

In establishments where the telegraphic communications do not require the constant attendance of a person to observe them, and where periodical attendance is sufficient, the signals may be correctly registered on paper, by connecting with the air-tube an instrument called a *pressure register*, invented by the projector of the *pneumatic telegraph*, which has been successfully employed in large gas light establishments upwards of fourteen years, for registering the variations of the pressure of gas in street mains. The same instrument produces, also, an increased range of the index scale, by which means the chance of errors from *minute divisions* is obviated.

It may be observed, that the introduction of railways has not only created an additional use for telegraphic communications, but the important difficulty which previously existed in the expense of providing a proper line and safe foundation, is at once removed by the site of the railway itself, possessing as it does, by its police, the most ample security against injury, either to the tubes or electric wires.

There being now three different projects for improvements in telegraphic communications, viz. the electro magnetic, the hydraulic, and the pneumatic telegraph,—and assuming that such improvements are of importance to the state, as well as to railway proprietors and the community at large, it seems desirable that their merits should be thoroughly investigated by competent engineers, and that the joint aid of Government should be solicited, in conjunction with that of railway proprietors, for the purpose of establishing, on a practical scale, the most eligible project.

The prominent questions for consideration seem to be—the certainty and accuracy of the communications, the first cost, the expense of repair and superintendence, also the time required for transmitting intelligence.

On the question of time, it is quite clear that neither the hydraulic nor the pneumatic can compete with the electro-magnetic telegraph in rapidity. No doubt, on investigation, each project will be found to possess its peculiar advantages. Thus, in considering the advantage one may have in point of time, another may possess a greater degree of certainty or accuracy in the communication, sufficient to outweigh the difference of time, for instance, between 1 second and 1 minute, or even between 1 second and 5 or 10 minutes.

The time occupied in transmitting intelligence by the pneumatic telegraph will depend on the capacity of the air tube, the degree of compression given, and the distance between the stations, but should greater despatch be required than is afforded by one tube, and the cost be of minor importance, several tubes may be employed, each fitted in the manner above described, so that all the figures contained in one telegraphic number, may be communicated at once with four tubes. Nine thousand nine hundred and ninety nine different signal numbers may be communicated, referring to so many words or sentences, and these numbers may be multiplied fourfold by letters A, B, C, &c., as indices to distinguish each series.

The projector of the *pneumatic telegraph* is not in possession of any results of experiments on a practical scale by the electro magnetic or by the hydraulic telegraph, employed at any considerably extended distances; or of their continued operation for any considerble period of time; nor can he offer much decisive information, of a practical nature, analogous to the long pneumatic telegraph on these points; the following circumstances may, however, be referred to:

There has been upwards of twenty years' experience in the transmission of gas for illumination through conduit pipes of various dimensions. In several instances, the gas has been supplied at the distances of from five to eight miles by low degrees of pressure. As one proof of great rapidity of motion, it has been observed, that when any sudden interruption in the supply has occurred at the works, the extinction of all the lights, over large districts, has been nearly simultaneous. Another instance of the great susceptibility of motion which frequently happens, is the flickering motion of the lights at great distances when water has accumulated in the pipes.

The only experience in the transmission of atmospheric air through conduit tubes, which applies more particularly to this question, may be referred to at three railway establishments; viz. Edinburgh, Liverpool, and Euston-square, London. In these establishments, air-tubes, from $1\frac{1}{4}$ to 2 miles in length, have been employed for the purpose of giving notice when a train of carriages is ready to be drawn up the inclined plane by the stationary engine at the summit, so that it may without delay be put in motion. This notice is communicated by blowing a current of air through the tube at the foot of the inclined plane, and sounding an organ-pipe, a whistle, or an alarm bell at the stationary engine. It will be satisfactory to know, that this operation has been regularly performed from two to four years without one single failure or disappointment.

Lond. & Edin. Philos. Mag.

Description of a Compensating Barometer, adapted to Meteorological purposes, and requiring no corrections either for Zero, or for Temperature. *By* SAMUEL B. HOWLETT, ESQ., *Chief Military Draftsman, Ordnance.* *Communicated by* SIR JOHN F. W. HERSCHEL, Bart., K.H., V.P.R.S., &c.

In the instrument here described, there is provided, in addition to the ordinary barometric tube (inverted, in the usual way, in a cistern of mercury,) a second tube of the same dimensions, placed by the side of the former, and likewise filled with mercury, but only to the height of twenty-eight inches above the level of the mercury in the cistern. This tube is closed at its lower end, and fixed to a float supported by the mercury in the cistern: and it bears, at its upper end, an ivory scale, three inches in length. The elevation of the mercury in the barometric tube is estimated by the difference between its level and that of the mercury in the closed tube; and is measured on the ivory scale by the aid of a horizontal index, embracing both the tubes, and sliding vertically along them. As the float which bears the closed tube, to which the scale is attached, rests freely on the mercury in the cistern, and consequently always adjusts itself to the level of that fluid, no correction for the zero point is needed; and as every change of temperature must similarly affect the columns of mercury in both the tubes, after the scale has been adjusted so as to read correctly at any given temperature, such as 32°, which may be effected by comparison with a standard barometer, every other reading will correspond to the same temperature, and will require no correction. The author considers the error arising from the difference of expansion corresponding to the different lengths of the two columns of mercury, and which will rarely amount to one four-hundreth of an inch, as too small to deserve attention in practice, being, in fact, far within the limits of error in ordinary observations.

Idem.

Invention of Photogenic Drawings.

It appears from an article in the London Athenæum, that a M. Niepce had entered upon the investigation of this mode of copying, quite as early as M. Daguerre. The former was in England in 1827, and left with some of his friends there several specimens of his execution, nearly as perfect as those now produced. It appears however, that "he was long and zealously assisted by M. Daguerre, who had been many years engaged in similar pursuits; and there is legal proof that, so early as 1829, they entered into an agreement, by which they declare themselve '*associés pour exploiter le procédé á l' invention duquel ils avaient concuru l'un ct l'autre.*'

But the most curious fact, (adds the Athenæum,) in relation to this discovery remains to be told. It would appear, considering the character of the pictures, all but impossible that impressions from them could be multiplied after the manner of an engraving; M. Daguerre, indeed, stated to us that it was impossible, and it is but reasonable to believe that he is as fully informed of the nature and extent of the discoveries as M. Niepce himself. Yet, in 1827, M. Niepce not only declared that it was possible, but produced specimens of such multiplied copies, and Mr. Baner has now in his possession, not only copies of engravings, fixed permanently by the action of light, not only scenes from nature, *but metallic plates engraved, and engravings copied from them:* and he understood and believes that no engraving tool was used, but that *the drawings were fixed by the action of light, and the plates subsequently engraved by a chemical process, discovered by M. Niepce.* If so, the greatest secret of all remains yet to be made public, and is, we believe, as unknown to M. Daguerre as to others. Mech. Mag.

Light Drawn Pictures.

Our vivacious Parisian neighbours have certainly the facility of making the most, in words, of anything they chance to lay hold of. "M. Daguerre's ingenious discovery," says the Paris correspondent of the *Post*, "which has assumed the name of 'Daguerrotype,' continues to excite very great curiosity and admiration. It is affirmed that the Emperor of Russia has offered 500,000f. for his secret, and that he has declined the munificent reward. It is not likely that his friend, M. Arago, will succeed in obtaining a larger national one from the Chambers." Mr. Talbot's communications to the Royal Society have made the processes public property here, had they not been so before. Sir John Herschel has turned his attention to the subject and has already obtained pictures from the light of Daniell's great galvanic battery; Sir David Brewster too, has commenced an investigation into the matter.

[illegible]

To the Editor of the United States Gazette.

Dear Sir:—A scientific friend having kindly sent to me, from Paris, a paper containing the authorized explanation of the process of M. Daguerre, which has attracted so much attention, I have made an abstract of it, which is at your service. The condition under which M. Daguerre received a pension from the French Government was, that he should make all the steps of his process public. His communication was first made confidentially to a Committee of the Institute, and M. Arago, acting as their organ, states that some of the steps of the process are not explicable by known laws. Yours,

A. D. B.

The Daguerrotype Explained.

The Academies of Sciences and of Fine Arts of the Institute, met on the 19th of August last, to hear the explanation of the process of M. Daguerre, from the perpetual Secretary, M. Arago.

It appears that in the earlier attempts to form a permanent picture of external objects, by the aid of the camera obscura, chloride of silver was used as in the method of Photogenic Drawing of Mr. Talbot. In this case the light blackens the paper, the depth of the shade being proportionate to the intensity of the light; the lights are thus represented by dark parts of the picture, and vice versa. M. Niepce first ascertained that an effect the reverse of that just mentioned might be produced by using a particular kind of bitumen, dissolved in oil of lavender, and that this picture might be preserved. The picture formed upon the bitumen required, to render it fully visible, the use of petrolium, which acted upon the parts of the picture not affected by the light. This process was a very imperfect one, requiring a long time for its execution, and yielding but imperfect results. The invention had been brought to this stage, when M. Daguerre undertook to improve it; by many curious experiments, and much labor, he was gradually led to his present process, the details of which present some very strange, and so far unexplained phenomena.

A sheet of copper, plated with silver, is carefully cleaned on the silver side by the aid of nitric acid. The cleansing requires great care and especial precaution, the plate requiring to be rubbed backwards and forwards in a fixed direction. Plated copper is found to answer better than silver. The plate thus prepared is exposed to the action of the vapour of iodine. For this purpose, it is placed in a box upon the bottom of which a small quantity of iodine is strewed, separated from the plate by a gauze screen, so as to diffuse the vapour uniformly. The plate must be enclosed in a metallic frame, to prevent the vapour from acting more upon the edges than near the centre, the success of the whole operation depending essentially upon the uniformity of the coating of iodide of silver, which is formed upon the surface of the plate. A yellow tint indicates that the plate has been sufficiently long exposed to the action of the vapour. It is then transferred to the camera obscura carefully excluding it meanwhile from the light. M. Daguerre is understood to have made some improvements in this instrument; to understand the progress of the present operation, however, it is only necessary to observe, that a plate of ground glass having been previously placed so as to receive a distinct image of the object to be delineated, the prepared silver plate is substituted for it. The effect is immediate, but is only very slightly preceptible. The plate is next exposed to the action of the vapour of mercury, and a condition stated to be essential is, that it shall be placed under a particular angle. It is therefore placed in a second box, at the bottom of which is a small trough of mercury, heated to between 160° and 170° Fahrenheit, and if the picture is to be viewed when hanging vertically, the inclination of the plate to the surface of the mercury must be 45°. The vapour of mercury appears to affect only the parts which have been already acted upon by the light, forming, probably, an amalgam of mercury and silver. After this operation the plate is dipped into a weak solution of hypo-sulphite of soda, and then washed with distilled water. The process is now complete, and the plate presents a drawing in which the light and shade is truly represented, and which may be exposed, without change, to the action of light.

Progress of Civil Engineering.

Clegg's Patent Atmospheric Railway.

The idea of employing the pressure of the atmosphere as the tractive force for propelling railway carriages has long been entertained; it was brought forward by Mr. Vallance several years ago, but in a form so crude and impracticable as to receive but little attention. It was again revived by Mr. Pinkus in his "Pneumatic Railway" scheme, but without success, although the apparatus was very ingeniously constructed. The subject has now, it appears, been taken up by Mr. Clegg, whose mechanical abilities are well known, and the pamphlet before us records the successful results of this gentleman's late experiments at the Southwark Iron-works, belonging to Messrs. Samuda, of which an account appeared in the *Mining Journal*, at the time.

We extract entire the following account of the invention and the experiments, with their results:—

"Clegg's atmospheric railroad is worked by stationary steam-engines, apart from each other two to five miles, according to the nature of the country. Two engines are fixed at each station, one for the up and the other for the down main, excepting on long inclined planes, where one engine only is required at the same points.

"The power of these engines varies according to the gradients and traffic. Supposing the traffic to be 2500 tons per day, say 1250 tons each way, and the velocity required to be thirty-five miles per hour, the average power employed on the line would be equal to six-horse per mile. The size of the engines will vary from six to twenty-five horse power, according to the gradients. The power is communicated to the train by means of a main or pipe laid between the rails, which is exhausted by air-pumps worked by the engines. This pipe is divided into lengths or sections (varying according to the respective distance of the engines) by valves, which are opened by the train as it goes along; and a space is left between each section, with proper sidlings for stopping the trains when necessary. The pipe suited to the above mentioned traffic would be ten inches in diameter. A piston is fitted to the pipe in such a manner that it will slide air-tightly therein. The pressure on the back of the piston (when the pipe is exhausted to the degree required for the steepest ascents) will produce a vacuum equal to a column of mercury twenty inches high.

"An available tractive force is thus obtained of 714 lbs., which will draw a train weighing thirteen tons up an ascent of one in fifty. With engines of the before named power, the train can be impelled at the rate of thirty-five miles per hour, and the sections of the pipe exhausted with sufficient rapidity to admit of a train being dispatched each way every ten minutes; or, if we make allowance for all possible delay, four trains each way may be transmitted per hour, making a total of 2496 tons per day.

"To the first, or driving, carriage of the train an arm from the piston is attached. This arm passes through an opening about an inch and a half wide, extending the whole length of the pipe on its upper surface; and this opening is covered by a valve, the nature of which constitutes the peculiarity of Mr. Clegg's system; and is, by a simple and efficacious contrivance rendered absolutely air-tight. The construction and action of this valve cannot be clearly explained without reference to diagrams or models, but the following account of experiments made by Messrs. Samuda, at Southwark Iron-works, will be sufficient to prove its efficacy:—

"The first of these experiments was made with a pipe three and five-eighth inches diameter, and thirty feet in length, which was laid level, and was exhausted by an air-pump of twelve inches diameter, worked by four men. Although the joints were but roughly and imperfectly made, a vacuum was attained when both ends of the pipe were plugged, equal to a column of twenty-five inches mercury, and but little less when the piston was in the pipes. This piston raised eighty-four pounds weight perpendicularly over a pulley, besides drawing a carriage on the railway, which weighed 160 lbs.

"The next trial was made on an ascent of one in thirty, with the same air-pipe, but increased in length to 102 feet, and exhausted by the same air-pump, which was on this occasion attached to the steam engine at the works. A cock was also placed close to the pipes, to separate them from the pump, when required for the purpose of better ascertaining the leakage in the pipe itself. A vacuum gauge was attached to each end of the pipe, to ascertain the time that would be required to obtain an equal vacuum throughout its whole length. On this occasion the carriages, which were loaded with iron, weighed *twenty hundred weight*, and were drawn up with great ease. The vacuum at both ends of the pipe was obtained at the same moment of time, and the two gauges rose and fell simultaneously. In order to ascertain the real leakage in the pipe and continuous valve, the ends of the pipe were plugged, when the vacuum gauge rose to twenty seven and three-fourth inches of mercury. The cock was then shut, and the mercury was six minutes in descending, showing a leakage in 102 feet length of pipe of only three fourths of a cubic foot per minute.

"The main pipe is put together with deep socket joints, in each of which an annular space is left about the middle of the packing, which is filled with a fluid, and thus any possible leakage of air into the pipe is prevented. Should the fluid pass through the packing, a circumstance very unlikely to occur, it can be easily replenished.

"A receiver is attached to each steam-engine, having an internal capacity as large as the section of pipe which the engine has to exhaust. This receiver is exhausted by the air-pump when the train piston is not in the pipe, so that the engines are constantly at work, after one train has passed generating power for the next. The pipe itself is also exhausted in the interval between the exit of one train and the entrance of another. No pipe is laid on a descending plane, except where that descent occurs in the middle of a section, in which case the pipe has no valve or lateral opening, and is laid below the surface. Whenever a train has passed out of a section of pipe, the pump is employed, first, to exhaust the receiver to the greatest possible degree, and then to exhaust the pipe to the degree required for the train."

We find that the estimated expense of a railway, constructed on Mr. Clegg's principle, falls short of 10,500*l.* per mile, the present cost being, as is well known, about 40,000*l.* It is also estimated that the current expenditure will be greatly reduced by the new plan. We do not pretend to offer any hasty opinion of the merits of a system which, if successfully carried out, promises to embrace such extensive results, but we consider that it possesses strong claims upon the attention of engineers, and all who are interested in railway undertakings. Min. Jour.

Dublin and Kingstown Railway.

April 11, an adjourned meeting of the shareholders was held for the purpose of considering the propriety of a rise in the fares of the 2d class carriages from 8*d.* to 9*d.* per passenger. The English proprietors were those who were most anxious for the rise. There was indeed a division at the board on the subject, some directors advocating a rise and others not. Ultimately, the resolution was carried for the rise in question, by 345 to 208, to commence May 1st instant. It appeared in the course of the discussion, which was long and animated, but conducted with great good feeling, that the railway was originally to cost 150,000*l.* and to pay 20 per cent. profit. It, however, cost nearly 300,000*l.* and paid only about 4¼, though the income is progressively increasing.

Out of an income of 35,000*l.* per annum, owing to the interest of borrowed capital and expenses, only 6,000*l.* is left to be divided among the proprietors. [Is there not a sinking fund going on to pay off 100,000*l.* borrowed of the Government, which is the main cause of so small a part now divided among the proprietors?—Ed.] Several gentlemen, as Mr. Cadbury, Mr. Kincaide, Mr. Twigg, Mr. Palmer, Mr. Roe, Mr. Barton, &c., addressed the meeting, some for, and some against the proposition. Mr. Pimm, jun. (we believe the secretary), having been called on to give his opinion, argued very satisfactorily against the advance, though for the sake of unanimity, he would vote for it. He was an advocate for even lowering the 3d class prices from 6*d.* to 4*d.*, for which he adduced several good practical arguments. Mr. Pimm observed:—"The Brussels and Antwerp Railway is 27½ miles in length, and that between Liverpool and Manchester 30 miles, the difference in length is immaterial. During the year 1836, 523,000 persons travelled by the Liverpool line, and 873,000 by the Brussels line, but great as the difference is it becomes more striking when the relative amount of the population is considered. In Liverpool, Manchester, and Warrington, the population is 486,000, and in Brussels, Antwerp, and Mechlin, only 209,000. The increase is easily accounted for—the corresponding fares are—

Liverpool and Manchester.	Brussels.
s. *d.*	*s.* *d.*
6 6	3 0
5 6	2 6
4 0	1 2

But the results elsewhere are equally striking. On the Paris and St. Germain Railway, 12 miles in length, the lowest rate was 10*d.* There were no complaints at either side, but the directors of that company, on calculating that they could convey a much greater number without adding materially to their expenses (exactly our case), came to the resolution to lower the fares to 15 francs [cents?] (7½) for the 12 miles. The result has been such an increase of passengers as considerably to increase their income (hear)."—Abridged from *Saunders's News Letter.* We confess our opinion goes with Mr. Pimm, very forcibly advocated by Mr. Twigg. The Dublin and Kingstown Railway is only 6 miles long, and if any alteration was to be made in the fares, we should be inclined to reduce them from 1*s.*, 8*d.*, and 6*d.*, to 9*d.*, 6*d.*, and 4*d.*, or 3*d.*; we feel persuaded it would tell better to the company in the end. It is a fact apparently strange, but, when examined, very easy to be explained, that an engine in an ordinary passenger-train will take along 60 or 80 persons with little or no sensible difference in the expense to that which is required to carry 20 or 15. This we were informed was observed years back on the Liverpool and Manchester line, and as Mr. Pimm justly observes, has been since noticed on the Paris and St. Germain Railway. Our sagacious neighbours immediately saw the account to which it might be turned, and reduced their fares from 1 franc, or 10*d.*, to 15 cents, or 1½*d.* The consequence, as Mr. Twigg says, was an increase in 12 weeks, from 91,000 to 130,000; and as Mr. Pimm observes, "such an increase of passengers as considerably to increase their income." So great a reduction, however, was carrying the principle too far, and nothing but the almost exhaustless resources of a capital to draw the traffic from could justify it.

Railway Mag.

Side motion (or rocking) of Railway Engines effectually prevented.

Sir,—My attention having been drawn to the lateral and shaking motion of engines upon railways, and believing it to be in proportion to the weight of the cranks and gearing, and the position in which the outside cranks, if any, are placed, I made a small model of the engine crank shaft with two wheels upon it, in the proportion of one inch to the foot, which I placed upon two strong upright wires, the wires made fast in a piece of board. I attached a weight to a string wrapped round the middle of the crank shaft, for the purpose of giving a certain degree of velocity to the crank and wheels, by falling a certain distance, say from the table to the floor. The weight I attached would turn the shaft and wheels 75 seconds, and the swing of the cranks produced *a lateral and oscillating motion* sufficient to cause the model to move, or jump, across the table on which it was placed. I then placed a weight on each wheel sufficient to *balance the cranks*, and with the same weight to give motion, and traveling the same distance as in the first case would turn the crank shaft and wheels, although heavier than before, 90 seconds, and the model stood steady where it was placed upon the table.

I submitted my experiments to the Engineers of the London and Birmingham Railway, who, instructed by the Directors, ordered one of the Company's engines (the Brockhall, at that time under repair at Mr. Middleton's, the Vulcan Iron Foundry, Birmingham,) to have balance weights applied to it, according to my plan, and under my superintendence. The engine when set to work, with the balance weights on the wheels, had one uniform steady pull at its work; the side sway was gone; it ran equally steady, whether it made 6 or 160 strokes per minute, which is not the case with railway engines generally, for the greater the speed the greater the snatching and swinging motion. After the engine had worked seven weeks, and had acquired the reputation of a very steady engine, I, with the consent of the engineers of the railway, removed the *balance weights* from the wheels and found the same snatching and swinging motion with this engine as is common to all locomotive engines of the usual construction; I found that, the engine, when running at, or upwards, of 22 miles per hour, would advance and recede from and to the tender from three-quarters of an inch to an inch every stroke of the engine, and proved the advantage of the balance on the engine equal to the effect on the model. Persons acquainted with railway locomotion will from the foregoing statements, readily see the great and many advantages to be derived from so simple and yet so effective an arrangement.

Yours respectfully, G. Heaton.

P.S.—Since writing the above, I understand the spirited and enterprising manufacturers of the Brockhall engine, have judiciously applied my balance weights to some new locomotive engines lately sent out by them. G. H.

Lond. Mech. Mag.

Mechanics' Register.

Cost of a Patent.

As many of our readers may wish to know the cost of that curious piece of furniture, called a "Patent for Invention," we subjoin the amount of fees payable on a patent of not more than one skin of parchment, granted to a single individual. If there be more than one patentee, or more than one skin of parchment, or if the patent be opposed, the charges are considerably increased in England:—

Reference to Attorney-General	£2	2	6
Royal warrant	7	13	6
Queen's bill	7	13	6
Privy Seal office	4	2	0
Clerk of the Patents' office	15	14	0
Hanaper and Great Seal office	48	7	6
Fee at Attorney-General's chambers	4	4	0
Signet office	4	7	0
Cost of a patent in England	£94	6	0

Cost of a patent in Ireland . . .	106	17	7
Cost of a patent in Scotland	46	4	0

Min. Jour.

The New Light in the House of Commons.

The House of Commons on Saturday evening, was fully lighted for the first time with Gurney's Bude light, in the presence of several of the Ministers, and of a great number of members. The light is brought into the House on catoptric, and diffused on dioptric, principles, so that while it is exceedingly brilliant and effective, it is soft and pleasant. The lights are placed out of the House above the roof, and being insulated by plate glass, ventillation may be carried upwards or downwards, which is an important point. Of the various media through which the light was diffused, that of the crystal octohedron facets, combined with prisms, seemed to be the most generally admired. We understand that this light, which may be regarded as a new era in the science of illumination, is due to the public spirit of the Elder Brethern of the Trinity House, at whose expense the Bude light has been perfected for the greater security of our merchantmen and navy.—*Globe.*

Lond. Mec. Mag.

LUNAR OCCULTATIONS FOR PHILADELPHIA, NOVEMBER, 1839.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
14	6	32	Im. 42 Aquarii	6	101°	101°
14	7	41	Em.		336	351
15	5	44	Im. Uranus		126	103
15	7	2	Em.		312	307
17	6	2	Im. 60 Piscium	6	96	54
17	7	0	Em.		341	307
17	7	6	Im. 62 “	6	161	129
17	8	6	Em.		277	261
19	7	37	N. App. ☽ & *μ* Arietis 6, ☽ South 3.′8			
19	15	37	Im. ι Arietis	6	89	144
19	16	33	Em.		299	352
20	6	32	Im. *g* Pleiadum	5,6	156	100
20	7	12	Em.		251	194
20	6	19	Im. *b* “	4,5	118	63
20	7	13	Em.		289	232
20	7	6	N. App. ☽ & *e* Pleiadum 5, ☽ South 2.′2			
20	6	54	Im. *c* Pleiadum	5	151	95
20	7	38	Em.		256	199
20	6	59	Im. *d* “	5	47	351
20	7	21	Em.		1	304
20	7	23	Im. η “	3	63	6
20	8	0	Em.		346	290
25	13	49	Im. *q* Cancri	6	23	290
25	14	45	Em.		332	245
27	16	57	Im. *c* Leonis	5,6	86	58
27	18	5	Em.		193	186

Railway Mails.

A very ingenious apparatus has just been erected by order of government on the railroad from London to Liverpool, for exchanging the letter-bags conveyed by the traveling post-office, without in the least checking the speed of the steam-carriage. The bags are now taken and left, at any rate of speed, however rapid, at which the train may be traveling, thus considerably expediting the transit of correspondence, effecting a vast saving in the consumption of steam power, and though last, not least, in importance, getting rid of the liability of serious accidents to the parties employed in exchanging the bags in the old mode. Min. Jour.

Powers of Machinery.

In one branch alone (the cotton trade), some spindles, which, before the new improvements were projected, used to revolve fifty times in a minute, now perform six, seven, and in some cases, 8000 revolutions, in the same short space of time. In one establishment at Manchester, there are 136,000 spindles kept in incessant motion by steam power, by which they are enabled to spin 1,200,000 miles (not yards) of cotton thread per week. The weekly produce of this article, when the machines are in full work is about 400,000,000 of miles, or enough to encompass the earth 160 times. Ibid.

Meteorological Observations for May, 1839.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
				Inch's	Inch's			Inches.	
	1	56	62	29.78	29.78	S.E.	Moderate.	.14	Rain—do.
	2	58	76	.64	.65	S.E.	do.	.81	Drizzle—rain.
	3	50	64	.90	.90	W.	Brisk.		Clear—do.
	4	39	54	30.00	30.05	W.	do.		Clear—do.
	5	42	69	.00	29.85	S.W.	do.		Clear—do.
☽	6	46	68	.05	30.05	W.	Moderate.		Clear—do.
	7	60	68	.04	29 96	W.	do.		Clear—lightly cloudy.
	8	48	79	.05	30.00	E.S.E.	do.		Clear—cloudy.
	9	62	81	29.85	29.85	W.	do.		Partially cloudy—do.
	10	56	62	30.03	30.03	N E.	do.		Cloudy—do.
	11	40	70	.00	.00	N.E.	do.		Clear—do.
	12	44	72	29.93	29.93	W	do.		Clear—do.
⊗	13	48	72	.95	.75	E.S.	Brisk.		Lightly cloudy—do. do.
	14	54	67	.55	.55	N.W.	Moderate.	1.15	Rain—Clear.
	15	51	80	.74	.60	W.	do.		Clear—do.
	16	60	82	.75	.75	E.S.W.	do.	.05	Clear—flying clouds—aain.
	17	54	72	.76	.80	N.W.	do.	.22	Clear—shower.
	18	52	64	.90	.90	E.W.	do.		Cloudy—clear.
	19	52	75	.95	.95	W.	do.		Clear—do.
☾	20	55	83	.80	.80	W.	Brisk.		Clear—do.
	21	60	76	.75	75	E.	Moderate.		Cloudy—do.
	22	63	76	.70	.70	E.	do.	.50	Partially cloudy—rain.
	23	52	57	.95	30.00	E.	do.	.36	Cloudy—rain.
	24	53	67	.95	29.90	E.W.	do.	.36	Tnunder shower —cloudy
	25	60	81	.75	.75	S E.	do.	.05	Shower—clear.
	26	64	78	.76	.77	E.S.W.	do.	.14	Clear—rain.
	27	62	76	.63	.55	E.	do.	1.10	Cloudy—rain.
🌝	28	52	73	.46	.46	W.	do.	.05	Cloudy—shower.
	29	55	65	.46	.50	W.	do.		Clear—do.
	30	48	69	.65	.65	W.	Brisk.		Clear—do.
	31	55	68	.70	.70	W.	do.		Cloudy—do.
	Mean	53.26	71.16	29 81	29.80			4.93	

	Thremometer.		Barometer.	
Maximum height during the month.	83.	on 20th.	30.05	on 4th 6th & 8th.
Minimum " "	39.	4th.	29.46	28th & 29th.
Mean	62.21.		29.805	

JOURNAL
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OF THE
State of Pennsylvania,
AND
MECHANICS' REGISTER.

OCTOBER, 1839.

Practical and Theoretical Mechanics and Chemistry.

Observations on Dr. Gries' Mode of introducing Air for heating Apartments. By R. Hare, M. D. *Professor of Chemistry in the University of Pennsylvania.*

To the Editor of the Journal of the Franklin Institute.

Sir.—In an article in the number of your Journal for August last, Dr. Gries urges that in conveying hot air into apartments for the purpose of warming them, it is expedient to have it enter near or through the floor. He anticipates that his views will not be considered as new, but presumes that if the course which he recommends has been pursued before, it has been through *mere accident where it happened to be the most convenient arrangement, and not upon any well understood principle.*

The opinion expressed by Dr. Gries, has been long entertained, and acted upon by me; and in my lecture room, has been verified during ten years past. This must be sufficiently evident from the following paragraph in a description of my laboratory, which was published with a former edition of my text book, and republished in Silliman's Journal and the London Philosophical Magazine and Journal.

> "The laboratory is heated by stoves under the arches beneath the hearth; of which one is included in a chamber of brick work. The chamber receives a supply of fresh air through a flue terminating in an aperture in the external wall of the building; and the air, after being heated, passes into the laboratory at fifteen apertures, distributed over a space of thirty feet. Twelve of these apertures are in front of the table, being four inches square, covered by sheet iron full of holes. In the hearth there is one large aperture of about twelve by eighteen covered by a cast iron plate, replete with perforations. Two other apertures for the admission of the hot air are under the table. By these means the air heated by the stove is, at its entrance, so much diluted with the air of the room, that an unusually equable temperature is produced; there being rarely a difference of more than two degrees of Fahrenheit, between the temperature in the upper and in the lower part of the lecture room."

Agreeably to the expedient described in the passage above quoted the currents of air entering through nearly 500 perforations, are so intermingled with the comparatively cool air of the room as to prevent the tendency to rise which Dr. Gries justly deprecates as tending to transfer the air to the upper portion of the room.

I beg leave to assure Dr. Gries that this arrangement was adopted after reflection, and upon principles which I supposed myself to understand; and which I have endeavoured to explain to my class during my course of lectures for many years. An engraving and description of my lecture room were attached to a former edition of my text book in which the peculiarity to which I have alluded was mentioned.

"I will take this opportunity of stating that the air received as above mentioned is supplied from a chamber in the cellar of about 12 feet square, heated by an anthracite stove; and that I consider it highly advantageous to have a cavity for the stove of these unusually large dimensions and also an ample influx of fresh air from the exterior of the building through a flue, or a trunk, provided for the purpose."

Evidently an equal rise in the temperature of an apartment may be effected by a small mass of air intensely heated, or a large mass moderately heated; the quantity being inversely as the temperatures: but in the one case, the particles of vegetable or animal matter which are always floating in the atmosphere are not liable to be decomposed, while, in the other case, their decomposition ensuing in consequence of the undue heat, is productive of that unpleasant effluvium which characterizes stove rooms. The warmth imparted to the air of my lecture room, is like that which results from a change in the weather; it has no attribute which would lead an observer to suppose it to arise from a stove, or from a culinary fire of any kind.

I will also take this opportunity of mentioning, that at first I found a great difficulty in getting cast iron to withstand the long continued and occasionally intense heat of an anthracite fire, as supported in stoves employed to heat chambers as above mentioned. Agreeably to my subsequent experience this difficulty may be surmounted by employing a comparatively large cylinder for the fire place, with a grate of about half the diameter. By these means the heat being chiefly in a vertical column, of which the grate forms the base, a thickness of several inches of fuel in a comparatively low state of ignition, is interposed between the iron and the hottest part of the fire. The coal in fact serves as a lining to the iron. The diameter of the cylinders which I use is at bottom twenty inches, while that of the grates associated with them is only eleven inches.

Though the term cylinder is employed, the casting to which it is applied is really a hollow conical frustrum about two inches less in diameter at the upper end, than at the base. This lessens the weight of metal and yet answers at least as well as if the shape were that of a true cylinder, because the upper half is less exposed to the fire than the lower.

Notice of advances made in the Science of Mineralogy during the year 1837. *From the Report of Berzelius to the Swedish Academy.*

Berzelius' "Annual Report" to the Swedish Academy "of the progress of the Physical Sciences," presents us with a very full account of the advances made during the year preceding that in which it is published, and although treating in some measure of them all, is more valuable to the chemist and mineralogist from the accompanying notes of the learned author on the subjects respectively described. Through the medium of French and English Journals, we are put in possession of many of the observations and discoveries of continental philosophers in all branches of the physical sciences excepting in mineralogy; and believing that among the large number of subscribers to this Journal there are many who would feel an interest in the progress of the latter science, the mineralogical committee of the Institute propose making free translations from Berzelius' work, by noticing the advances made in the science during the year 1837, the account of which was handed in to the Swedish Academy in the Spring of 1838, and was published in Germany in the early part of the present year.

Com. Mineralogy.

Babinet (Pogg. An. xli. 115,) examined the optical characters of minerals and their utility, and comprehended them under six divisions; 1st, absorption of light without polarization or refraction; 2nd, absorption with polarization; 3rd, dichroïsm and polychroïsm; 4th, appearances analogous to lunar rings, &c.; 5th, a star or analogous phenomena; 6th, chromatic polarization (crosses and black lines with surrounding rings.) This performance appears to possess great interest, in illustrating the theory of refraction of light in different bodies with a cristalline texture, less, however, for facilitating the means of recognizing minerals.

Von Kobell[*] projected a scale of the fusibility of minerals as an additional means of distinguishing them before the blow-pipe. He selected the following of increasingly difficult fusibility.

1. Sulphuret of antimony.
2. Natrolite or mesotype.
3. Almandine or precious garnet.
4. Actynolite or light green hornblende.
5. Adularia or orthoclase.
6. Diallage.[†]

Fine splinters of these minerals are compared with similar ones of the mineral to be examined, and the fusibility expressed by one of the six numbers, annexing a decimal number to give the exact grade between that and the next higher number. Thus the capability of fusion of Hypersthene is expressed by 5.5; that of Datholite from 1.8 to 2, that is, it is nearly as fusible as natrolite. These examinations cannot attain great accuracy, but will be of value in connection with other experiments with the blow-pipe.

Breithaupt,[‡] in continuing his determination of the specific gravity of minerals, has given that of ninety-eight species, and has farther compared that of fourteen from different localities which have been viewed as pitchblende.

Suckow[§] has described a reflecting goniometer the results of measurement with which do not depend on the evenness of the surfaces, and give the inclination of both brilliant and dull surfaces towards each other.

New Minerals.

Protoxide of Palladium.—The palladiferous gold from the mines of Gorgo Soco in Brazil, is coated with ochreous matter precisely similar to hydrated peroxide of iron, which Johnson found to contain protoxide of palladium. This statement has been confirmed by Lampadius,* who found that 100 grains of the metallic particles, with their oxidized coating were resolved into 40.7 grains of gold containing palladium, and 59.3 grains which dissolved in the hydrochloric acid. Ammonia gave a yellow precipitate, soluble in an excess of the precipitant, and from the filtered solution, cyanid of mercury threw down palladium.

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[*] Journal für practische Chemie x, 258.

[†] It is not known which kind is referred to. *Tr.*

[‡] Journal f. pract. Chemie, x; 151.

[§] Ibid. 158.

Breithaupt† has described the following seven new minerals.

Peroxide of Lead,(Schwarzbleierz,) from an unknown locality supposed to be *lead hills*, forms a scaly mass, surrounded with carbonate, phosphate and sulphate of lead. The color is black, with a brown streak; the mass compact, enclosing crystaline particles; fracture uneven; brittle. Sp. gr. 9.332 to 9.448. Before the blow-pipe it first yields oxide of lead and then a metallic globule of the same metal.

Copper-blue, from the mine Herren Seegen, in Schoppachthal in Baden, is a hydrated silicate of peroxide of copper with alumina and oxide of iron. Color sky-blue; streak, smalt-blue, shining, brittle, adhesive to the tongue. Color improved by water, which renders it translucent. Sp. gr. 2 56.

Malthacite (from μαλθακος, fat, which it resembles,) was found by Törmer among disintegrated blocks of basalt near Steindörfel, between Löbau and Baudissin. Color white with yellowish tinge; faint waxy lustre; translucent; forms thin plates, rarely in mass; uneven, conchoidal fracture, easily severed; greasy to the touch; falls to pieces in water. Sp. gr. 1.996 to 2.01. It consists, according to an analysis of O. Meissner, of

Silica, ...	50.2
Alumina, ...	10.7
Lime, ...	0.2
Oxide of iron, ...	3.1
Water, ...	35.8,

approaching to the formula $F\ S^4 + 3\ A\ S^4 + 5$ aqua. Decrepitates before the blow-pipe, gives water, but does not melt.

Variscile (from Variscia, the Latin name of Voigtland,) occurs with quartz near Messbach in Saxon Voigtland. It is a hydrated phosphate of alumina, oxides of iron and chrome, magnesia and ammonia. Color apple-green, streak white, waxy and glistening; translucent; in a kidney-form mass; conchoidal, somewhat uneven fracture; separates easily; greasy to the touch. Sp. gr. 2.345 to 2.378. Before the blow-pipe gives an ammoniacal water and assumes a rose-color, is infusible at a higher temperature and becomes colorless; the chrome reaction is not distinctly produced by the fluxes; borax-glass may be rendered cloudy by flaming.

Lavendulan is an arseniate of cobalt adulterated by arseniate of nickel and copper, occurring in the Erzgebirge near Annaberg, in the mine Galilæische Wirthschaft. Color lavender-blue; lustre between waxy and vitreous; translucent; kidney-form; conchoidal fracture; easily severed into shelly separations. Sp. gr. 3.014. Before the blow-pipe yields water, exfoliates, becomes bluish gray, and loses its cohesion; easily fuses in the pincette, and is surrounded with a blue flame; the bead crystalizes on cooling, like phosphate of lead, but becomes black; some show a dark hyacinth red color. On charcoal, it emits fumes of arsenic, and is reduced to an arseniuret.

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* Journal für practische Chemie xi, 311.

† Do. do. x, 501.

The borax-glass is slightly tinged with cobalt, which is singular enough if cobalt is the principal constituent.

Diadochite (from διαδεχειν, to replace another, because it is an iron-sinter (pharmacosiderite) in which phosphoric acid wholly replaces the arsenic acid,) occurs in the alum-slate quarry of Arnsbach, near Schmiedefeld in Saalfeld. Color dark wax-yellow, passing into brown; lustre between waxy and vitreous; streak colorless, slightly translucent; is kidney-form or stalactitic; fracture conchoidal, easily severed. Sp. gr. 2.035 to 2.037; contains 36½ pr. ct. water, a trace of sulphuric, but no arsenic, acid, and is a hydrated per-phosphate of iron.

Symplesite (from συμπλησιαζειν, to have nearer neighbors,) is an arseniate of iron of unusual color, the well known green compound of a proto and per-salt, communicating to this mineral a bluish color. It occurs in the iron mines of Lobenstein in Voightland. Color pale indigo-blue, sometimes between this color and celadon-green, rarely between mountain and leek-green, and then only superficially; forms flat, needle-shaped crystals, which exhibit a pearly lustre on the more perfect planes; translucent to semitransparent. Sp. gr.= 2.957. It contains 25 to 26 pr. ct. water, becomes brown by ignition, emitting an arsenical odor, and ignited on charcoal becomes black and magnetic. Beside the proto and per-arseniate of iron, it probably derives its bluish tinge from phosphate of iron.

After reading descriptions of minerals similar to those given above, it is impossible to withhold the remark that there are many industrious mineralogists who study the physical characters of minerals too much in minute detail, make their classification, and give names accordingly, and are nevertheless at fault in solving with accuracy the main question as to what the mineral really is. The time will, however, come when mineralogists will consider the main question to be the determination of the composition of a mineral. The assertion of Mohs, that no part of chemistry belongs to mineralogy, (on which Cuvier properly remarked, "qu'il a fait reculer la science") will probably expire with non-chemical mineralogy, for it would otherwise be no true science, and until that period arrive, its descriptions will resemble the marks on a package of unknown goods.

A. F. SVANBERG and C. TENGER presented to the Museum of the Academy of Sciences a new mineral found by them in the felspar quarry of Ytterby. It is carbonate of yttria. It generally occurs as a thin, white coating, which has latterly been observed in the fissures of gadolinite. But it is now found on another mineral, and in such quantities as to allow of a chemical examination. In a few instances, they thought it exhibited signs of a fibrous, crystaline structure.

In a succeeding number we shall notice new examinations of minerals formerly known, either by full translations or extracts from the Jahresbericht of Berzelius, of which we have above offered an example.

COM. MIN.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN OCTOBER, 1838,

With Remarks and Exemplifications by the Editor.

1. For a *Crane for Loading and Discharging Vessels*; Thomas Goodwin, city of New York, October 2.

A vertical shaft is to be placed on board a vessel, or on a wharf, &c.

The lower end of this shaft is round, and it is made to revolve, holes being pierced through the deck, if placed on board a vessel, to receive it. Two gibs furnished with pulleys at their upper ends project from opposite sides of the vertical shaft, and these may either be fixed, or raised and lowered by guyes. The rope by which the goods are to be hoisted and lowered passes over the pulleys at the upper ends of the gibs, descending thence between them to a drum, or barrel fixed in the shaft at a proper height to be turned by a winch; round this drum the rope takes two or three turns. By turning the drum, barrels, or packages of any kind, may be raised by one end of the rope, and lowered by the other, and so on alternately. When the goods are suspended the crane is to be slued round, so as to deposit the package on a wharf, or on board of another vessel.

The claim is to a crane of the foregoing construction, "for hoisting and lowering weights, so that two weights, one to be raised, and the other to be lowered, shall, in whole or in part, be made to counterpoise each other, substantially in the manner above set forth."

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2. For *Laying off and Dressing the Runner of Mill Stones;* Charles Vest, Stokes county, North Carolina, October 2.

Four of the lands on the runner are to be laid out with a particular curvature towards the centre of the stone, and the intermediate furrows are also to be made of a length, and in a manner, designated, which the patentee says will cause the stones to work better than in the old way; and the claims are to this mode of laying out. Perhaps the plan may possess all the virtues ascribed to it, but not being very sure of this we do not think it necessary to describe it more particularly.

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3. For an improved *Cultivator and Weeder;* Simeon M. Marshall and Joseph W. Coburn, Dracut, Middlesex county, Massachusetts, October 3.

This cultivator has two handles, of the ordinary form, and teeth, or hoes, which are also similar to others; its peculiarity consists in its running on two wheels, one behind the other. A wheel of about two feet in diameter is situated about the centre of the machine, and another twelve or fourteen inches in diameter, in front. The particular use or object of this arrangement is not stated, and the claim is to "the frame in which the wheels work, constructed and operating as above described, in combination with the weeding harrow," &c.

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4. For an improved *Level and Plumb;* Lemuel Lewis, Newfield, Tompkins county, New York, October 3.

This instrument is denominated "the balance and pendulum level and plumb." The indications are to be made by means of levers, or rods, inserted in a piece of wood, which may be two feet long, two inches broad, and an inch and a half high. The level indicator is a bar of iron hung on pivots at its centre. It is examined through a small pane of glass covering its end, allowing the mark to be seen by which its position is ascertained. The plumb indicator is hung like a pendulum, at a suitable distance from its pointed end; its opposite end being weighted to act as a pendulum. It is inspected in the same way with the level.

The claim is to "the so hanging the level and plumb, on pivots, in the box or case, as to have them indicate the true level and perpendicular, by pointing to marks on the brass plates at the ends, as above described."

5. For a metallic *Napper for Napping Cloth;* John M. Pratt, Dudley, Worcester county, Massachusetts, October 3.

This machine is said to be an improvement on Hurd's patent Metallic Napper. The metallic points which are substituted for teazles are to be soldered to a strip of tin, or other thin metal, which will possess elasticity, instead of being confined to an unyielding piece, as in Hurd's. These points stand in rows along the napping cylinders, and between each row there is a gauge, consisting of a strip of wood, or of metal, which is capable of adjustment, so as to regulate the action of the points upon the cloth. The claims are to "the mode described of fastening and forming the points or pins into flats so as to preserve their elasticity, and give them play between the gauges; and the mode of regulating the gauges so as to equalize and perfect the operation of napping."

6. For an *Ice Boat;* Jacob Townsend and Walter Hunt, city of New York, October 3.

Across, and in advance of, the bows of the boat there is to be a revolving cylinder, driven by a chain band actuated by the paddle wheel; this cylinder is to act upon the ice, being guided by suitable arms, and is furnished with teeth or spurs on its outer surface, by which the ice is to be broken. The claim is to the foregoing arrangement; in which there certainly is no more of novelty than was necessary upon a liberal construction of the claims to secure a patent. We do not know whether time and experiment have told the tale of its utility, but are very apprehensive that their report will not be of a character to gratify the inventors.

7. For a *Hill Side Plough;* Isaac Teeter, Johnstown, Pennsylvania, October 3.

This patent is taken for the particular manner devised by the patentee for tilting the mould board from side to side, and the fastening it in place so as to cause it to throw the furrow alternately in opposite directions.

8. For an improvement in *Fire Arms;* Samuel Adams, Springfield, Hampden county, Massachusetts, October 3.

The main object of this invention is said to be the combining in the same barrel, a rifle and a smooth bored gun. The gun is to be of that kind which receives its loading at the breech, by the insertion of a metallic cartridge into a smooth bored gun. When it is desired to convert this gun into a rifle, a barrel is to be inserted at the breech, which will fill the bore of the smooth gun, and project beyond its muzzle, where it is to be drawn up and secured by a screw ferule. A projecting rim on the rear end, is at the same time drawn against the shoulder on which the metallic cartridge was received. When used as a rifle, a movable sight is to be brought into action.

Claim.—"What I claim as my invention is the combining of one barrel within the other, in manner, and for the purposes herein set forth and described. I also claim the making the back sight of a rifle to turn on a pivot, in manner, and for the purpose set forth.'

We very much doubt whether the manufacturing of combined guns upon the above plan, will ever be carried to an extent which will enable the patentee to repay the cost of a patent, as it seems to be one of those whimsies which may afford personal gratification to an individual, but is not likely to come into extended use.

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9. For *Elliptical Springs for Carriages;* George B. Robinson, Pawlet, Rutland county, Vermont, October 3.

The manner of combining elliptical springs for carriages has undergone numerous modifications, which within a few months, have been made the subject of patents, some of these are undoubtedly real improvements, whilst others are mere variations in the mode of connecting and combining the parts. The spring before us consists of a double pair of elliptic springs, one placed immediately above the other, and each having a sliding groove through which a pin passes, confined by a nut, or button, to allow of lateral play to the ends of the springs, they being divided where they bear upon each other.

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10. For a machine for *Picking Oakum, Curled Hair, &c.;* Hiram Burnham, Boston, Massachusetts, October 5.

The picking is to be effected between toothed cylinders, and the invention of any of the particular parts of which the machine consists, is disclaimed, the claim being confined to "the arrangements of the whole, and their combination together, forming a machine for the purpose herein above specified."

It is very rarely that a claim like the foregoing is allowed to pass in the office, it being in general required that the substantial novelty in a new combination of old devices should be pointed out. We cannot do this.

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11. For an improvement in the construction of *Railroad Cars*; William A. Davis, city of Baltimore, October 5.

Claim.—"The invention claimed consists in the arrangement of the main springs under the trucks, in the centre of the car, and suspending the same by links from said trucks, upon which springs the whole load, body and gear, are sustained by bolts projecting from the gear, passing through the trucks, and resting upon the convex surfaces of said springs. Also in arranging the side springs on the tops of the trucks for sustaining the car body in an upright position, in combination with the main spring, or springs."

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12. For a combined *Rocking and Castor Chair;* John David Brown, city of New York, October 5.

When this chair is to be used upon rockers, the back legs are removed; and when these are replaced the chair stands upon castors, it being thrown forward so as to rest upon those on the front legs, just in advance of the rockers. The claim is to this arrangement.

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13. For a machine for *Washing and Dressing Feathers;* Jonathan W. Howlet, Greensborough, Guilford county, North Carolina, October 5.

The operation of this machine is similar to that of several other feather dressers in which the feathers are to be agitated in a cylinder, under the influence of moisture and of heat, and does not contain any thing worthy of special notice.

14. For a machine for making *Butt Hinges;* Charles R. Macy, Hyde Park, Dutchess county, New York, October 5.

The hinges to be made by this machine are formed of strips of metal, which are to be first cut into halves, by means of a cutting press, so as to leave the projecting pieces ready to form the knuckle, the two halves corresponding in this particular. These pieces are to be bent upon a pin, or joint former, by means of the machine, which we shall not attempt to describe, for although not unnecessarily complex, its construction cannot be well made known without reference to the drawing. The claim is to the particular arrangements of the parts as described.

15. For an improvement in the *Croze for Coopering;* James F. Broadhead, Kingston, Ulster county, New York, October 8.

"The object of my invention is to construct an instrument resembling, in many particulars, common circular bent planes, which shall cut the channeling in barrels, or any cask of a similar nature; and the result is that an instrument such as will be hereafter described, will perform this in a most perfect manner, without the operator being compelled to have recourse to more than one tool, as has been necessary in the employment of those heretofore known and used, and may be denominated the combined stock-trowel and croze."

The claim is to the particular form of the face and cutter, as represented in the drawings, so as to complete the channel in casks of all descriptions at one operation.

16. For a machine for *Hulling and Cleaning Grain;* Jeduthan Cross, Lisle, Broom county, New York, October 8.

This machine consists of a hollow metallic cylinder placed horizontally, and having revolving beaters within it, which act upon the grain as it passes from the upper side at one end, to the lower side at the opposite end, where it escapes and is operated upon by a fan. The numerous machines for the purpose of cleaning grain, usually denominated smut machines, differ from each other principally in the form given to the beaters, and to the projecting points, by which the grain is to be acted upon, and to them the claims refer; in the present instance the patentee claims "the structure of the inside of the cylinder, composed of longitudinal and notched projections, intersected obliquely by smooth projections; the grooves running spirally around the front end of the said interior; and the relative positions of the hopper, the fan, and the flue." We have no doubt whatever that in the different patented machines, several may be found which are equally good in their operation, and that some have been patented which, could strict justice have been meted, would not have passed the office, but the question of similarity of means, where there is considerable difference in form, is one replete with embarrassment, and where doubts are entertained the claimants must be allowed to settle the question of their rights in a court of law, the office granting the patent to enable them to do this.

17. For a machine for *Planting Seeds;* William Buckminster, Framingham, Middlesex county, Massachusetts, October 8.

This machine is intended to plant two rows of seed at the same time, and for this purpose it has two hoppers, one on each side piece of the frame. This frame constitutes a harrow, with two rows of teeth, one row on each of the side pieces, the hoppers being placed immediately over the hind tooth. The claims are to "the loose joints in the planting harrow, and the setting of the teeth so as to follow directly after each other, as described; the mode of drawing the seed out of the hopper by means of an oblong rectangular cup; the gauge to regulate the quantity of seed; the mode of rising or sinking the sill on the wheel, so as to raise or sink the hind tooth, and thereby bury the seed deeper or more shallow in the earth, all as described."

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18. For an improved *Self Sharpening Plough;* John W. Post, city of Baltimore, October 8.

The claim is to "the peculiar manner of combining the share with the mould board and land-side, and the manner of regulating the position of the share by means of the slot or slots, in the share, as represented."

The difference between this self-sharpening plough and some which have been before patented, is very small, consisting, as will be seen by the claim, in the manner of fastening the share.

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19. For *Preventing Dust from Thrashing Machines;* Joseph Ross, Boundbrook, Somerset county, New Jersey, October 8.

Oblong pieces of wood, or other material, the length of the cylinder of a thrashing machine, are to have pieces of leather, or other suitable substance, projecting from one of their edges, forming a kind of comb, and these pieces are to be placed on the bonnet of the machine, so that the comb may pass between the teeth of the cylinder, and prevent the rising of dust from the grain. The claim is to "the attaching of one or more combs, or racks, such as is herein described, to the inside of the bonnet, or outer covering of a thrashing machine, on that side of the cylinder opposite the concave, or that part of the machine which contains the grain during the operation of thrashing, for the purpose set forth."

A device of this kind may be adapted to some cylinder thrashing machines, but it cannot be of universal application to the numerous kinds which have been patented. Its operation also must be imperfect.

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20. For a machine for *Shelling Corn;* Lester E. Dennison, Saybrook, Middlesex county, Connecticut, October 8.

The corn is to be shelled by means of a revolving cylinder, set with teeth spirally, the corn being borne up against the cylinder by an apparatus furnished with a spring. The affair is not very clearly described, and does not appear to have any particular claim to the time and space necessary to the making its peculiarities known.

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21. For an *Annular Saw* for sawing timber; Robert Grant, city of Baltimore, October 8.

This circular saw is to consist of a flat ring with the teeth upon its periphery. It is in fact like the common circular saw with its middle portion removed so as to leave a rim of two, three, or more inches in width. The saw is to be placed in a suitable frame furnished with friction rollers, which bear against its inner edge, and support it. In order to drive it, conical friction rollers are made to bear against its sides, opposite to each other, and these are to be driven by a band, or gearing.

Claim. "What I claim as my invention is the annular saw for cutting timber, and the arrangement of the adjustable friction rollers, and beveled wheels, in combination with, and for the purpose of driving, the saw, as set forth."

We believe that this saw is new in its construction, and it is well calculated to remove the difficulty of *buckling*, from elevation of temperature in the cutting edge. It appears likely, however, that its defect will be a want of stiffness, and that it will be liable, therefore, to chatter when in use.

22. For an improvement in the *Grist Mill;* Oliver Stevens, and Ezra Goodell, Port Lawrence, Lucas county, Ohio, October 10.

This patent is for a portable grist mill, the peculiarities of which are sufficiently made known by the claims, which are as follows:

"What we claim as our invention is the manner of securing the upper stone in an independent frame, by the use of the diagonal bolts, applied as set forth, by which the frame can be screwed up, and the stone firmly embraced, whenever it may be necessary. We also claim the hanging of the independent frame of the upper stone with hinges, allowing it to be turned back at pleasure, when the bolts are removed by which it is secured to the lower frame. We claim likewise the arrangement for hanging the lower stone, and regulating it by means of the square iron box, the square headed spindle, and the regulating screw, in their combined capacity."

23. For a machine for *Ditching and Embanking;* Linton Thorn, city of Washington, October 10.

Various machines have been devised for the purpose of ditching and embanking, with a view, principally, to their employment in the extensive prairies of our country, where this procedure is the only one which can be followed in the formation of fences; the ordinary mode of digging and throwing up the earth by hand, is one of great labor and expense. A machine for this purpose, invented by Mr. George Page, was some time since essayed in the city of Washington, on very hard ground, and promised well, but such difficulties as usually attend new machines, have interfered with its introduction, and what are its present prospects we are not informed. The machine named at the head of this article has also been tried, but from a want of due strength, and some defects in the arrangement of the parts, it awaits improvements, and further trial.

The subjoined claim will afford a general idea of the construction of the cutting part of this machine. The cutters are made to revolve by horse power, and the earth cut is raised by means of an endless apron of sheet iron, and thrown on one side of the ditch to form an embankment, as the machine proceeds.

Claim. "What I claim as my invention and desire to secure by letters patent, is the construction, and manner of operating, the within described apparatus for ditching or excavating the ground; that is to say, I claim the arrangement of the cutters, as described, attached to and carried by a vertical, or nearly vertical, shaft, and forming in their revolution the frustum of an inverted cone, the sides being sloped in any degree which may be desired. I claim likewise the advancing of an excavating machine, as it cuts the ground, by means of an endless screw operating either regularly, or by an intermitting motion produced by the irregularity of the thread of the screw, as herein set forth. I also claim the giving of an intermitting motion to such a machine by means of a toothed wheel, or by a ratchet wheel, combined and operating substantially as set forth."

24. For an improved *Trunk Lock;* Joseph Nock, city of Philadelphia, October 10.

We cannot attempt to give the particular arrangement of the bolt, the tumblers, and the other parts of locks of this description. The permutations which these may be made to undergo, are too numerous for them to be written down, and were we to attempt it, it is not improbable that our description would be, at least, as inscrutable as the lock itself; this, however, we think a good one, being strong, and certainly difficult to pick. It does not differ essentially from some other locks made by the same manufacturer, excepting in the formation of the bolt by which it is adapted to trunks.

25. For an improved *Silk Spinner;* Harrison Holland, Northampton, Hampshire county, Massachusetts, October 10.

The claim made is to a "method of stopping the machine when a thread breaks, by means of the drop rods, which throws the drums and whirls out of gear, in the manner described; and also the means of changing the twist by means of the short cylinders, in the manner described."

In the explanation of this machine there are upwards of fifty references to the drawing, yet it does not appear to be unnecessarily complex. Small perpendicular rods are suspended to each of the threads by bent wires, and should a thread break the rod which was suspended by it drops, and the extreme end of a lever to which it was attached is raised, comes in contact with a pin, or cog, on the periphery of the drum, and operates in such a way as to throw it out of gear and stop the machine.

26. For an improved *Horse Power;* Jerub A. Fay, Baltimore, Maryland, October 10.

The horse is to walk upon a wheel either placed horizontally, or somewhat inclined. Under that part of the wheel upon which the horse stands there is a drum, or roller, which sustains the weight, and is, by the bearing of the wheel thereon, to drive the machinery to which the power is to be applied. Two other friction wheels are to be placed so as to prevent the tilting of the main wheel, whilst they do not prevent the weight of the animal from being sustained, mainly, by the drum. The claim is to "the manner of balancing the wheel upon which the horse is to walk, on its centre, without a vertical shaft, in combination with the mode of bracing the same, and of sustaining the part upon which the animal is to walk."

27. For a *Planing Machine;* Joseph Lombard, Boston, Massachusetts, October 13.

The cutters of this planing machine are affixed upon the surface of a revolving horizontal table, those near its periphery operating as jack plane irons, and others within them as fore plane, and smoothing, irons. The stuff is to be fed in above the table, between feeding rollers, and a revolving brush is to clean the face of it as it passes in. The claims are "1st, The combination of the parts together, substantially as described, forming a machine for planing and reducing boards. 2d. The revolving brush for the object and purpose hereinbefore set forth."

The claim is rather more indefinite than is usually admitted, as it does not point out any special arrangement, or combination of the respective parts. and we apprehend that its effect would be to confine the patentee to the precise arrangement as set forth.

28. For improvements in the *Hardening or Chilling, the inner surface, &c., of Hubs of Railroad Car, and other, wheels;* Hopkin Thomas, Beaver Meadow, Northampton county, Pennsylvania, October 13.

"The nature of my invention consists in placing a conical pin of wrought or cast iron in the centre of the aperture left in the sand, where the core, or composition of sand, is usually placed to form a hollow cylinder; also a plate, or washer, at the upper and lower end of the hub, or cylinder, which harden the metal coming in contact with them."

"What I claim as my invention in the above specification is the construction and application of a chilling surface on the inside and ends of the hubs or naves of cast iron railroad car wheels, wagon boxes, or other cylindrical bearings; made by means of the combined chills, as described; also the construction and application of a groove made as described, within such chilled hub, or nave, wagon box, or other cylindrical bearing, for the reception of any lubricating substance."

When said wheels are cast, the chill pin is to be knocked out as soon as the metal has set, and water is to be poured into the cavity at intervals, so as to cool the hub as rapidly as other parts of the wheel, and thereby to prevent that tension which results from unequal cooling.

29. For an improved mode of constructing *Stoves*; James Miller, city of Baltimore, October 16.

This stove is intended for heating apartments, and is furnished with tubes, valves, and dampers, designed to govern and direct the supply of heated air from the stove to distant apartments. The claim refers to the special arrangements devised by the patentee; and as there does not appear to be any thing new in these devices taken individually, the claim is confined to the special arrangement of the parts. These we do not think it necessary to attempt to set forth, as we are very apprehensive that the invention is not likely to be sought after.

30. For *Stoves for Warming, and for Cooking;* Josiah Hill, Andover, Essex county, Massachusetts, October 16.

In this stove many devices are combined which are confessedly to be found in other stoves, and the claims refer, by letters, to these special combinations. The whole appears to be arranged with skill, particularly in its adaptation to cooking; the only objection to it which suggests itself is its being rather complex, although it is not more so than numerous other cooking stoves.

31. For a *Portable Furnace*; Jordan L. Mott, city of New York, October 19.

(See Specification.)

32. For a self tightening *Bush for Mill Spindles*; Henry Flinchbaugh, Lampeter, Lancaster county, Pennsylvania, October 19.

In this apparatus the mill bush has within it a divided follower, the outer portion of which is conical, so that it shall be made to embrace the spindle as it is forced into the bush. A forked lever, with a weight attached to it, is made to enter the bush, and the continuous action of the weight keeps the followers, or nuts, to their bearing on the spindle. For keeping the spindle oiled, a small tube passes down through the husk, and under the bed stone, comes up through the bush, an opening being left for that purpose, and is thus conveyed to the followers and spindle. The claim is to the foregoing combination.

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33. For an improvement in *Thrashing Machines;* Frederick and Henry Greib, Hagerstown, Maryland, October 19.

The improvement claimed is in the manner of forming and inserting the spikes in the cylinder and concave. The spikes are to be flattened on their projecting ends, and they are to be fastened by screwing them into the cylinders. They are represented as made of round iron, champhered on two sides towards their points, and the claim is to the particular mode of adjusting the spaces between the spikes, in the concave, and on the cylinders; the adjustment being effected by the peculiar form of the spikes, and the manner of turning them.

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34. For a *Stove for Heating Apartments;* William Beach, city of Philadelphia, October 19.

The upper part of this stove has a flattened flue, in an arborescent form, presenting a wide radiating surface. The claim is to "the giving to the flues of stoves the flattened arborescent form and figure, in the manner, and for the purpose, set forth." The validity of such a claim, admits of doubt, as a mere change of form does not present a subject for a patent; but as the change, in the present case, increased the radiating surface, for the purpose of more effectually diffusing the heat, we presume it was considered as a tenable foundation for a claim.

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35. For *Temples for Looms;* Emory A. Angel, Killingly, Windham county, Connecticut, October 19.

This temple resembles, to a considerable extent, others previously in use, but the jaws are connected together in a different manner. The claim is to "the manner in which the upper and lower jaws are combined; that is to say, by pins forming the hinge joints of the jaws; the whole being constructed substantially in the manner set forth." This temple is of the kind which holds the selvedge of the cloth between jaws, which are opened by the beat of the lathe; in their general construction and action, such jaws are well known to machinists.

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36. For apparatus for *Jointing, Tongueing, and Grooving Boards;* Walter M. Hutton, Troy, New York, October 26.

This patent is taken for the particular manner in which the head is formed to hold the knives or cutters of a revolving tongueing and grooving wheel. The description is very elaborate, as the patent is dependent upon minute peculiarities of form and arrangement, the general construction not differing from that of other revolving cutters.

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37. For a machine for *Cutting, and Removing, Obstructions under Water;* Smith Cram, city of New York, October 26.

A wheel having cutters on its periphery is to be made to revolve under water, said wheel being hung on the end of a long shaft, or boom, projecting out from the deck of a vessel, and made capable of being raised or lowered by suitable tackles. A revolving shaft passes along the boom, and is bevel geared into the shaft of the cutter wheel. A universal joint connects the two segments of the revolving shaft, to allow the boom, with its cutter wheel, to be raised or lowered. These are the main features of this apparatus, which, it appears, is intended to cut off logs, or similar articles, under water. The claim is to the above described combination, the main parts of which are recapitulated therein. We do not think that this machine can be made to answer the intended purpose, as, in the stillest water, the motion of a vessel must not only interfere with, but, we apprehend, entirely prevent its operation.

38. For constructing *Bedsteads;* Samuel P. Smith, Salina, Onondaga county, New York, October 26.

Instead of a mortise in the posts, a round, or other formed hole, is to be made in them, to receive the ends of the rails. These ends are to be tapered off, and the holes, also, made slopeing, that they may be adapted to each other; the posts and rails are then to be connected together by screws, in the ordinary manner.

Claim. "What I claim, is the manner in which I have combined and connected the above described tenon and mortise, whether in a round, four-sided, or other form, for the purpose of forming a tight and strong joint, which shall not become open or loose by use; that is to say, I claim the application of the principle by which tenons and mortises, larger at one extremity than the other, of a regular tapering form, are combined and connected in the construction of Bedsteads, in the manner above set forth."

39. For a *Machine for making Safety Fuse*, for communicating fire in blasting rocks; William Lewis, city of New York, Oct. 26.

The description of this machine occupies six large folio pages; and a claim is made to "The combination of the reel frame and reels with the hollow shaft, cone and case, for making the inner case of the fuse, and in combination with them the grooved rollers for compressing the inner case. Also, the combination of the reel frame and the reels and hollow shaft with the cone and case, for the purpose of making and putting on the outer case of the safety fuse; and, in combination with them, the grooved rollers for drawing off and determining the length of the fuse; the whole being constructed and operating in the manner substantially as herein described."

40. For a *Press for Cotton*, &c.; Alexander Jones, New Orleans, Louisiana, October 26.

The follower of this press is to be forced down in the first instance by means of racks and pinions, and, subsequently, when an increased power is required, by means of a screw. Two racks rise vertically from the follower, and into these gear two pinions on the same shaft, by the turning of which the follower is to be forced down. A vertical shaft having a screw cut upon its middle part, passes through the middle of the follower, and of the bed, and works in suitable boxes in the frame of the press, or the timbers of the building. On the upper side of the follower there is a divided screw nut, which, when the screw is not in action, does not touch the shaft; but when the follower has been forced down by means of the racks and pinions, the nut is, by means of levers, thrown into gear with the screw, and by turning the shaft in the ordinary way, the screw is brought into action. Two bales are to be pressed at the same time, one on each side of the screw shaft, which would otherwise be subjected to a great lateral strain.

The claim is to "the method of combining and working the screw, with the racks and pinions, wheel and shaft, in the same press, by means of two pieces of female screw nuts, constructed on the plan, and working substantially in the manner, and upon the principle, herein set forth, by means of which the expedition of the operation is greatly increased."

41. For a Machine for *Excavating and Embanking;* Geo. Page, city of Baltimore, October 26.

This machine was referred to in No. 23 of this list, as having been some time since essayed in the city of Washington. It consists of a vertical wheel, or drum, carrying cutters which are to cut the two sides and the bottom of the ditch, as the wheel revolves. The wheel is turned by means of a shaft and bevil gear, actuated by the power of a horse. The earth is raised in vibrating buckets, or receivers, which, when they arrive at the top of the wheel, deposit it on a lateral chute, down which it descends, to form the embankment. The claims are to the manner of constructing the vibrating receivers; the mode of causing the machine to advance by coiling a rope round a drum, and the manner of regulating the same; the attaching a circular platform, or horse walk, to advance with the machine; the manner of adjusting the cutting wheel, or excavator; the application of teeth to the side cutters; the supporting the inner end of the chute or the axle of the excavator; the mode of changing the width of the ditch, and the slope of the sides, by setting the cutters, in the manner described.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for an improvement in the art of increasing the strength of Wrought Iron and Steel. Granted to WALTER R. JOHNSON, *of the city of Philadelphia, July 9th,* 1838.

To all to whom these presents shall come: Be it known that I, Walter R. Johnson, of the city of Philadelphia, in the State of Pennsylvania, have invented a new and useful improvement in the art of increasing the strength of wrought iron and steel, and of articles formed of said materials, and that the following is a full and exact description of the machinery for carrying into effect the said improvement.

I construct a double trough or box of metal, or other convenient material capable of sustaining the action of fire, which trough I place over a flue or hot-air conductor supplied with hot air, gas, or smoke from stoves, fire-places or furnaces, situated at a convenient distance below it. Between the two parts of the said double trough or box, there is, included through the whole length of the same, a space, or cavity for containing and conducting the hot air, gas or vapour which I admit into it through holes or valves in the outer shell or box, over the hot-air flue already described. This cavity I call the *heating-box.* The form of the cross section of the heating box will depend on that of the two troughs which compose it, and will be either rectangular, elliptical, or formed of two arcs of circles greater than semicircles, or in any other form which may be most convenient for the kind of work to be done. The proportions of the length, breadth and height of the box must in like manner depend on the form and the quantity of the materials which it may be found necessary to place within it, at any one time. The two troughs constituting the heating-box, may be united by riveting, or formed together by casting. There is an opening on the top of the inner trough through its whole length, by which the materials to be operated upon are introduced; but a cover or covers of iron or other materials may be adapted to fit it in such a manner as to prevent the escape of heat from within. Said covers may be formed either of simple sheets, shaped in the proper manner, or they may be metallic boxes filled with charcoal-dust, or other non-conductors of heat.

The aforesaid box or trough is to be set in brick work, or other substantial fire-proof materials; and surrounded by non-conducting substances, except the top, ends, and such other parts as may be exposed for the purpose of bringing out the pyrometric rods hereinafter described. In the bottom of the outer shell or trough, or at the ends in the space between the two, are a number of holes for admitting hot air, gas, vapour, flame or smoke into the heating box; and from the top of said box, either at the ends, or at any convenient intermediate points, are flues or tubes for carrying off the hot air or gas, after it has traversed the heating box. In order to measure the temperature of the inner trough and of its contents, I employ any form of thermometer or pyrometer, or the expansion or fusion of any solid substances, or the evaporation of any liquid which may be found best adapted to each particular form and size of the apparatus. Bars of metal, either simple or compound, and traversing the heating box, either longitudinally, transversely, or in spirals, may by their expansion, be made to act on a lever or levers, wheel or wheels, and give motion to indexes moving over graduated straight or curved lines. For heating apparatus on a large scale, I employ the following construction of apparatus to serve as a pyrometer. On the inside of the inner trough, near the bottom, are two projections of metal, at a convenient distance apart, between which are to be placed the two ends of a bar of brass so long as to require to be bent or curved slightly, in order to be made to enter between the said projections, in one of which is a screw to regulate the curvature of the bar, by increasing or diminishing the pressure on its two ends. From the middle of the said bar of brass, there proceeds a rod passing out through the side of the double trough by holes perforated for that purpose, and the said rod gives motion to levers, or wheel work for moving indexes as before stated. Instead of connecting the brass bar to the side of the heating box, I shall sometimes attach it, in a manner similar to that above described, to a stiff bar or rod of cast iron, plumbago, glass or other substance of a low rate of expansion by heat; and shall, when necessary, use two bars of brass, on opposite sides of the same bar of the other material, so that they may form a bow each way from the central line or bar. In the latter case, the instrument will bear a near resemblance to Regnier's pyrometer, and the rod will pass from one brass bar to the other, to move the index situated on the latter, traversing in its course the intermediate bar of the material of low expansion. When the expansion of solids is employed for indicating the temperature of the heating apparatus, I make use of the same to close the holes in the outer box already mentioned, and to open a register from the flue beneath the heating box into an escape pipe connected with the same, thereby allowing the heated air to pass off without coming in contact with the inner trough. When I mark and regulate the temperature of my heating apparatus by the expansion of bars, and the motion of indexes and valves as already described, I graduate the scales over which said indexes are to pass, by ascertaining the points at which they stand at two or more given temperatures, in the following manner. After establishing the heating box and pyrometer firmly in their place, I surround the pyrometer with snow or pounded ice, which is allowed to remain until the whole apparatus has acquired a temperature of 32° Fah., which is marked at the point where the index then stands. Heat is then applied by lighting fires in the stoves or furnaces, the ice is melted and made to boil briskly, surrounding the pyrometer with boiling water or steam, and when the index becomes stationary, I mark the point 212°. The water is next removed, and around the pyrometer bars are wrapped leaves, strips or masses of pure tin, after which the heat is very carefully raised until they shall be perceived to be melting and falling off; the point at which the index then stands is marked 442°. A number of thin glass flasks of mercury are then disposed along, contiguous to the pyrometer bars, and when they begin to boil, the scale is marked 652° at the point denoted by the index. When I would mark higher temperatures than that of boiling mercury, I ascertain them by placing on or near the pyrometer bar, an iron vessel to hold melted tin, into which is plunged the standard piece of a steam pyrometer. The apparatus is then heated to any required extent, and, noting the position of the index, I withdraw the standard piece, and immediately plunge it into the boiling water of the pyrometer to which it belongs to ascertain in the usual manner the number of degrees which must be set upon the point which was given by the index, on taking the standard piece out of the tin. Another mode in which I regulate the temperature of the heating box, is, by making it air tight, but instead of using it as a passage for hot air, placing within it a quantity of mercury or other liquid having a high boiling point sufficient to occupy all that part of the lower, or outer, trough, which is exposed to the flue below it. The inner trough and the pieces of metal under process, will then be heated by the vapour of the liquid surrounding them. In this case, instead of flues in the upper part of the box to carry off the air, as above described, are placed funnel-shaped receptacles for the vapour of mercury, or other liquid, in which it may be condensed and flow back again into the heating box. A safety valve of the common form will be placed in this receptacle to secure the box from injury by explosion. When I apply the heating box to the purpose of heating pieces of great length, instead of establishing it on fixed and solid masonry, I place it on a car, together with its furnace and apparatus, and the said car together with its furnace and appendages, is then set on rails beneath the piece of metal to be acted on, and caused to move at a convenient speed, from one end to the other of the iron, communicating in succession the same temperature to every part of the piece. This method is particularly applicable to the wire cables used for sustaining suspension bridges.

To know when each part of the metal has arrived at the proper temperature, sheets of metal or of some alloy which melts at a temperature below 600° Fahrenheit, are disposed at short intervals along its whole length, and the velocity of the car is regulated by the readiness with which they are melted off. Instead of the kind of heating apparatus and machinery herein employed for increasing the strength of iron by the process of thermotension, I shall, when iron is manufactured by rolling, whether into bars or sheets, perform that process by drawing it for the last time, forcibly through the rolls, while the temperature is not above 600° Fahrenheit. In like manner, in manufacturing wire, I place a heating apparatus in such a position that the wire after passing the draw plate, shall be heated to 550° Fah. before it is wound up by the spool, or reel.

Another improvement which I have made on the art, or process of increasing the strength of iron and steel by the process of hot straining is, that instead of the usual forms of dynamometer, or apparatus to measure the force applied to the metal, I make use of a straight beam or lever, one end of which is loaded with any convenient constant weight, and near the other end is a gudgeon to take hold of two straps which are placed on each side of the beam. These straps are extended to any convenient distance beyond the beam and terminate in, or are connected with, the hook, or other holding apparatus for connecting the pieces of iron to the dynamometer. Between the said gudgeon and the weight at the opposite end of the lever, is placed the fulcrum, which is to be applied to the solid support of the dynamometer, but instead of consisting of a simple gudgeon, I form this fulcrum of a solid casting, or other strong piece of metal, bent twice at right angles, and having the lever traversing its middle section between the two projecting arms of the bent portion, each of which being then reduced to a proper bearing edge, they constitute together the *principal fulcrum.* The opening between the two parts of this fulcrum is intended to give room for the straps already described, and to allow the *fulcrum distance* to be diminished at pleasure. The weighted end of the beam plays between two quadrantal arcs of a circle, each of which is cut into a ratchet, and has on the side of the lever a click to correspond, which will support the lever at any elevation less than the whole length of the arc.

In using this dynamometer, the *ratchet-arc* serves as a register for the strength of the metal, being made to hold the lever at the elevation to which it would be raised by such a strain as would break the piece under trial at ordinary temperatures. Any addition to the force, will raise the loaded end of the beam. The graduated ratchet arc, is marked with the number of tons or other weights which the dynamometer measures, on the principle that the force applied on the shorter arm of the beam in a horizontal direction, will, if the beam be supposed to be, when unloaded, self balanced on its principal fulcrum, be directly proportional to the weight placed on the longer arm, multiplied by the length of that arm, and again multiplied by the sine of the angle measured on the arc, reckoning from the lowest point of it, and inversely proportional to the length of the shorter arm multiplied by the co-sine of the same angle measured in the manner just stated. The above described heating box is, when used, to be placed so that the mechanical power which strains the metal shall be at, or opposite to, the end of the box, and the dynamometer, above described, at the other, with proper holding machinery to connect each with the pieces of metal, which are to undergo thermotension.

What I claim as new in this invention is the above described double trough forming a heating box, with its apparatus, valves, registers, flues, receptacles for condensed vapour, and its other appendages, as the same are applicable to the purpose of increasing the strength of iron and steel, in the process of straining the same at a high temperature. I also claim the method of increasing the strength of bars, rods or plates of iron, by drawing them, while hot, through the rolls, by mechanical power, of any suitable kind. I also claim the increasing of the strength of wire, by heating the same after passing through the draw plate, as described above.

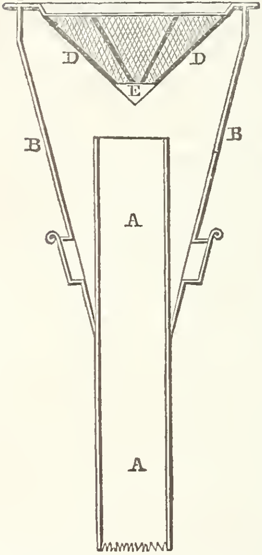
WALTER R. JOHNSON.

Specification of a Patent for a Spark Arrester, to be used on Locomotive and other Steam Engines; granted to Benjamin Briscoe, Engineer, City of Detroit, Michigan, December 15th, 1838.

To all whom it may concern: Be it known that I, Benjamin Briscoe, of the City of Detroit, in the State of Michigan, have invented an improved Spark Arrester, to be used on the chimneys of Locomotive and other Steam Engines, for the purpose of preventing the escape of sparks; and I do hereby declare that the following is a full and exact description thereof.

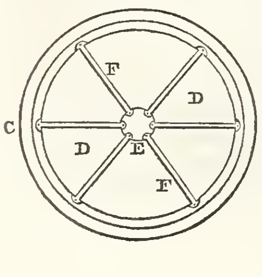
I surround the chimney of the engine by an inverted cone of sheet iron, the lower end of which embraces, and is attached to the chimney, at the distance of three feet, more or less, from the top of said chimney, its upper edge rising above the top of the chimney to the height of from twenty inches to two feet, where its diameter may be three times that of the chimney. To strengthen the upper edge of this inverted cone, and to sustain an inverted cone of wire gauze, I affix thereto an iron ring, which is so constructed as to answer another useful purpose, to be presently described. In the accompanying drawing, Fig. 1, is a vertical section of the chimney, and its appendages; and Fig. 2, a top view of the ring, with the ribs which are to support the wire gauze. A, A, is the chimney, B, B, the inverted cone of sheet iron surrounding it, the space between it and the chimney serving as a receptacle for the sparks and ashes; there being sliding or other doors, *a*, *a*, provided for removing them when necessary. C, C, is the iron ring which surrounds, and is attached to, the upper edge of the cone, B, B. This ring I usually make about three inches wide, its outer edges being attached to the cone, in consequence of which it projects inwards, lessening the diameter of the opening about six inches. Its lower flat side thus presents a space against which the sparks strike, which are conducted up to it by the inverted cone of wire gauze, where, not being subjected to any draught, they fall readily into the receptacle.

Fig. 1.



D, D, is the inverted cone of wire gauze, which is attached at its upper edge to the hoop C, C, and at its lower edge to a disk or piece of sheet iron E. This lower end may be about ten inches above the top of the chimney. F, F, Fig. 2, are ribs of iron to which to attach the wire gauze. The part which I have denominated the inverted cone of wire gauze may be a segment of a sphere, as well as of a cone, and may be made to produce the same mechanical effect.

Fig. 2.



The sparks as they rise from the chimney strike against the wire gauze, and from its position they are carried by the draught up its inclined sides until they come into contact with the under side of the ring, whence they fall, as already stated. The inner edge of the ring may be made to incline downwards, in the direction of the wire gauze. The difference between the action of the draught upon a flat, or a concave surface, in detaining the sparks, and the action upon such a one as I have described will be apparent; as its tendency in the former case is to cause them to adhere to, and in the latter to slide upon the surface, thus perpetually freeing it from their obstructing influence.

What I claim as my invention, and desire to secure by letters patent, is the employment, for the purpose of arresting sparks, of an inverted cone, or curved segment, of wire gause, combined and connected with the surrounding ring, and the other parts of the apparatus, substantially in the manner herein described. Benjamin Briscoe.

Specification of a patent for constructing Portable Furnaces; granted to Jordan L. Mott, *of the city of New York, October 19th,* 1838.

To all whom it may concern; Be it known, that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented certain improvements in the manner of constructing Portable Furnaces, and I do hereby declare that the following is a full and exact description thereof.

Fig. 1.

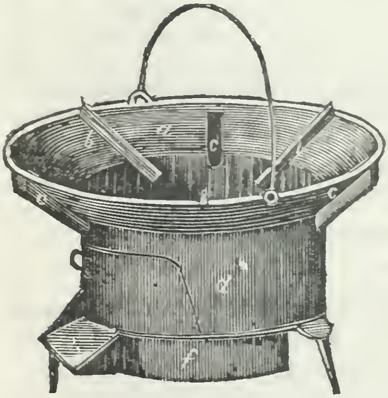


Fig. 2.

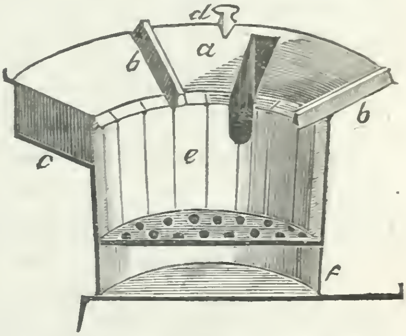


Fig. 3.

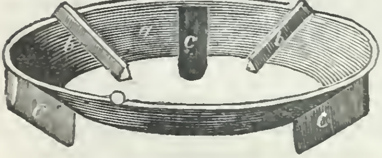


Fig. 1, in the accompanying drawings, represents the furnace in perspective. Fig. 2, is a vertical section through the middle of it; and Fig 3 shows the rim or flaring part, with its appendages separated from the cylindrical, or body part, of the furnace, for the purpose of employing it in a manner to be presently described. These furnaces are usually made of cast iron, and they may be made either in one or two parts, the rim or flaring part, *a*, *a*, being in the latter case attached to the cylindrical or body part, by screws or otherwise. Upon this rim I form three or more ridges or projections *b*, *b*, upon which the cooking utensils are to rest, the height of these ridges determining the flue or space between the rim *a*, and the bottom of the boiler, or other utensil placed thereon. I also construct three hollow, or deep recesses, *c*, *c*, into which the legs of iron pots may be received, so as to allow their bottoms to rest upon the ridges, *b*, *b*, or instead of this recess I cut openings or slots through the said rims, for the same purpose. The cylindrical part, *d*, *d*, I line as shown at *e*, *e*, with soap stone, fire-clay, or other nonconductor of heat. The ash pit, *f*, I usually make somewhat smaller in its diameter than the body, *d*, thus leaving an offset, upon which the lining may rest at its lower end, when the furnace is cast in one piece. I allow the inner ends of the ridges, *b*, *b*, to project within the edge of the rim, so as to cover, and in part to confine the lining in its place; when the rim is made separate from the body of the furnace, I allow the whole inner edge to project over so as to cover the top of the lining, and after completing the latter, attach the rim to the body, as before indicated. When the rim, with its appendages, is made separate from the body of the furnace, as shewn in fig. 3, I employ it to cover and surround any boiler hole in stoves, furnaces, ranges, or other cooking apparatus to which it may be adapted, so as to fit them to receive the various kinds of utensils in ordinary use, as pots, kettles, boilers, &c.

I do not claim the mere making of the upper part of a portable furnace flaring, this having been previously done, but not in the manner above set forth; what I do claim, therefore, is the making of a rim or flaring part, projecting out from the upper part of a cylindrical, or nearly cylindrical, body; and having upon it ridges, to support the utensils placed thereon, in the manner, and for the purposes set forth. I also claim, the providing of the recesses, or instead thereof, the making of slots, in such rim, to admit with equal facility the legs of pots of various sizes. I also claim the making and using of such rims, or flaring tops furnished with ridges, or with recesses, or slots, or with both, to be adapted and applied to the boiler openings in cooking apparatus of various kinds. JORDAN L. MOTT.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the relative Strength and other mechanical Properties of Cast Iron obtained by Hot and Cold Blast. By EATON HODGKINSON, Esq.

[CONTINUED FROM PAGE 196.]

Transverse strength.—It is to ascertain the resistance of materials to a transverse strain that the efforts of experimenters have chiefly been directed. One reason for this seems to be the great facility with which bodies can be broken this way comparatively with others, which require large weights or complex machinery, and often considerable attention to theoretical requirements.

In making the following experiments, it has been the author's aim, whilst he kept in view the inquiry respecting hot and cold blast iron, to make the results subservient to some other purposes, besides giving an extended view of the application of these irons.

As the inquiry was a comparative one, and required that a number of experiments, and those similar to each other, should be made upon each iron from any particular place, several models were made, and castings, both of hot and cold blast iron, obtained from them; and as it seemed desirable to trust in these experiments as little as possible to theory, some bars, one inch square, were always obtained from the same model. From these, and from others, a satisfactory comparison of the relative strengths of the irons would have been obtained without the use of theory, could the castings have always been got of the exact size of the model; but as small deviations in this respect were unavoidable, theory was employed to effect the slight reduction in the results of each bar to what they would have been if the bars had been of the exact dimensions of the models.

All the bars used in these comparisons are uniform and of the same length, and the theoretical assumptions with regard to the strength and deflection are of the simplest and most generally admitted kind. They are as below; the strength in rectangular bars is taken as the breadth multiplied by the square of the depth, and the ultimate deflection is supposed to be inversely as the depth. To these there has been added another, namely, that the power of bearing an horizontal impact from a given weight is measured by the strength of the beam multiplied by its ultimate deflection. This last assumption supposes that all cast-iron bars of the same dimensions in our experiments are of the same weight, and that the deflection of a beam up to the breaking weight would be as the pressure. Neither of these is true, they are only approximations; but the difference in the weights of cast-iron bars of equal size is very little, and taking them as the same, it may be inferred from my paper on impact upon beams (Fifth Report of the British Association), that the assumption above gives results near enough for practice.

After the following tables, therefore, there will always be given a summary of the strengths and deflections, reduced to what they would have been supposing the bar to be of the exact size of the model; and attached to these there will be the other values mentioned above, representing the power of the beam to bear impact.

The modulus of elasticity is set down that it may serve as a measure of the comparative stiffness of the irons. It is given in pounds per square inch.

The ultimate deflection attached to each experiment was derived from the results last obtained, and as these results were usually more numerous than those set down, the deflection cannot often be calculated from those which remain, but is nearer to the truth than those which might be obtained from the remaining ones.

In all the subsequent experiments, the bars were cast 5 feet long, and were supported on props 4 feet 6 inches asunder, except it is otherwise mentioned, which will only be found in two cases.

In the prosecution of the experimental part of this research, it gives me great pleasure to acknowledge the efficient manner in which my views were carried into execution by Mr. John Patchett, an intelligent pupil of Mr. Fairbairn.

Table I.—Results of experiments to ascertain the transverse Strength of Carron Iron, No. 2. All the castings were uniform throughout; they were cast 5 feet long (except otherwise mentioned), and supported during the experiments on props 4 feet 6 inches asunder; the pressure being applied in the middle. The weight of the bars, when given, are those of the whole length.

Hot Blast Iron, made with Coke.

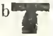
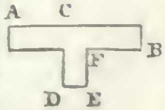
Experiment 1. Rectangular bar, 1.00 deep. 1.00 broad. Weight 15 lbs. 2 oz.			Experiment 2. Rectangular bar, 1.017 deep, 1.010 broad. Weight 15 lbs. 11 oz.			Experiment 3. Rectangular bar, .996 deep, 1.002 broad. Weight 15 lbs. 3 oz.			Ex. 4.—Bar 7 ft. long supported on props 6 ft. 6 in. asunder.—Its form of section broken as shown with the rib downwards.			Ex. 5.—Bar from the same model as the last, supported on props 6 ft. 6 in. asunder, broken with the rib upwards, thus.			Ex. 6.—Bar 5 ft. long, broke on supports 4 ft. 6 in. asunder, same form as before, but smaller vertical rib broken with rib downwards. 			Ex. 7.—Bar same as the last, broke with rib upwards.		
Weight in lbs.	Deflection in inches.	Set, or deflection when unloaded.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inch es	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
16	.037	visible increased				16	.038	visible	7	.015	visible	7	—	not vis.	112	.20		112	.20	
23	.052		23	.051	visible	23	.052	. .	14	.032	.001?	14	.025	visible	168	.30	.01	224	.40	
30	.070	.001?	30	.067		30	.070	.001?	21	.046	.002	21	.045	.002	196	.36		280	.50	.02
56	.132	.002	56	.129	.001	56	.133	.004	28	.064	.004	28	.065	.003	224	.42	.02	336	.60	
112	.271	.008	112	.261	.006	112	.276	.009	56	.130	.005	56	.134	.005	252	.49		392	.72	.07
224	.588	.037	224	.561	.030	224	.598	.040	112	.273	.020	112	.270	.015	280	broke		448	.84	
336	.940	.087	336	.900	.077	336	.958	.094	168	.444	.035	224	.580	.058				560	1.12	.18
448	1.360	.181	448	1.297	.153	448	1.388	.187	224	.618	.058	336	.895	.101				672	1.47	
469	broke		476	broke		462	broke		280	.813	.093	448	1.224	.155				784	1.92	
									336	1.030	.130	560	1.585	.235				896	2.55	
									364	broke		672	1.985	.330				952	2.95	
												784	2.410	.490				980	broke	
												896	3.450	.722						
												1008	4.140	1.040						
												1064	—							
												1120	broke							
Ultimate deflection=1.444			Ultimate deflection =1.400.			Ultimate deflection =.446.			Ultimate deflection =1.138.			Fracture caused by a Wedge 2.92 in. long and 1.05 deep flying out of the form $\overbrace{\quad}$ Ultimate deflection =4.830			Ultimate deflection =.55			Fracture caused by a wedge 4.9 ins. long flying out of the form $\overbrace{\quad}$ Ultimate deflection =2.15		

TABLE I, continued.

Ex. 8.—Bar an isosceles triangle. Base 1.43 in. Each side 2.00. Broke with the vertex downwards ▽			Ex. 9.—Bar same as the last, filed to the exact size. Broke with vertex downwards as before. ▽			Ex. 10.—Bar same as the last, but one-tenth of the depth taken off the vertex. Broke with vertex downwards. ▽			Ex. 11.—Bar cast 1¼ inch square, and reduced in the middle to 1.019 deep, 1.021 broad.		Ex. 12.—Bar cast the same as last, and reduced in the middle to 1.013 deep, 1.017 broad.		Ex. 13.—Bar a rectangle, 3.00 inches deep and 1.03 " broad.			Ex. 14.—Bar a rectangle. 4.95 inches deep. 1.02 " broad. Length 5 feet, Weight 75 lbs.			Ex. 15.—Bar from the same model as the last. 4.97 inches deep. 1.02 " broad. Weight 77 lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Set.	Weight in lbs.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	.07		112	.07		112	.075		112	.01	112	.005	1082	.085		5867	.127		4936	.105	
168	.11		168	.102		168	.11	.004	168	.025	168	.02	1343	.106	+	6798	.153	.01	5867	.133	.009
224	.15	.002	224	.140	.002	224	.15	.005	224	.04	224	.05	1474	—	.001	7730	.177		6798	.152	.01
336	.24	.01	336	.22	.01	336	.24	.01	336	.10	336	.15	1605	.130	.003	8661	.207		7730	.190	
448	.33	.02	448	.31	.015	448	.34	.017	392	.15	392	—	1866	.156	.006	9593	.235		8662	.223	
560	.44	.04	560	.40	.03	560	.44	.035	448	.21	448	broke	2126	.185	.010	10524	.275	.03	9034	it bore	
616	.50		672	.51	.05	672	.55	.06	504	broke			2388	.212	.012	11087	broke		9220	broke	
644	.53		784	.62	.08	700	.59						2649	.243	.017						
672	broke		812	broke		728	broke						2910	.272	.022						
													3172	.307	.03						
													3433	.340	.038						
													3694	.378	.05						
													3956	broke							
∴ Ultimate deflection=.56.			∴ Ultimate deflection=.65.			∴ Ultimate deflection= 63.							∴ Ultimate deflection=.416.			∴ Ultimate deflection= 299.			∴ Ultimate deflection=.244.		

Notes. Two samples have been obtained of both the Hot and Cold Blast Carron Irons, No. 2. The first five experiments in Table I, and the first three in Table II, were from samples obtained after all the other experiments on this iron had been made; they perhaps give results a little higher than those previously obtained.

In experiments 4, 5, 6, 7, the transverse section of the casting may be represented by A, C, B, F, E, D, where A B and F D are parallelograms, each part being of uniform thickness. In experiments 4 and 5 the area of the parallelogram A B=5×.30 inches, the thickness being .30. In the former of these experiments C D=1.45, and D E (which may represent the uniform thickness of the rib D F)=.36 inch. In the latter experiment C D=1.56, and D E=.365 inch. These two experiments were the only ones where the castings were more than 5 feet long. The castings in Experiment 6 and 7 give nearly as follows: Area A B=5×.27 inch, C D=1.27, D E=.25 inch.



Results of the Rectangular Bars above reduced to those of Bars 1 inch broad, and 1, 3, and 5 inches deep. Distance between supports 4 feet 6 inches.

	Specific gravity	Modulus of elasticity in lbs. per square inch.	Breaking weight in lbs. (*b*).	Ultimate deflection in in's. (*d*).	Product $b \times d$ or power of resisting impact.
Experiment 1st, bar one inch deep and one inch broad .	7020	16269000	469	1.444	677.2
Do. 2nd, do. do.		15901000	456	1.424	649.3
Do. 3rd, do. do.	..	..	465	1.144	532.0
	Mean	16085000	463	1.337	619.5
Do. 11th, do. do.	7031	..	475		
Do. 12th, do. do.	7008	..	429		
	Mean	..	452		
Do. 13th, three inches do.	..	..	3843	.416	1598.7
Do. 14th, five inches do.	7070	..	10957	.298	3265.2
Do. 15th, do. do.	7100	..	9149	.243	2223.2
Mean	7046	..	10053	.270	2744.2
Results of Experiments not reduced.					
Experiment 6th, bar-rib extended	..	..	280	.55	154.0
Do. 7th, do. compressed	..	..	980	3.15	3087.0
Do. 8th, Triangle	..	..	672	.56	376.3
Do. 9th, do.	..	..	812	.65	527.8
Mean	..	..	742	.60	452.0
Do. 10th, Frustum of do.	..	..	728	.63	458.6

TABLE II.—Results of experiments on the Transverse Strength of Carron Iron, No. 2. Lengths of bars, and distance between the supports as before. Cold Blast Iron made with Coke.

Ex. 1.—Rectangular bar 1.025 deep, 1.002 broad. Weight, 15 lbs. 6 oz.			Ex. 2.—Rectangular bar 1.021 deep, 1.015 broad. Weight, 15 lbs. 11 oz.			Ex. 3.—Rectangular bar 1.040 deep, 1.026 broad. Weight, 16 lbs. 2 oz.			Ex. 4.—Uniform bar. Form of section. ⊤ Broke with the vertical rib downwards.			Ex. 5.—Bar from same model as the last. Broke with the vertical rib upwards. ⊥			Ex. 6.—Bar from the same model as in experiment 6 Hot Blast. Broke with the rib downwards.			Ex. 7.—Bar from the same model. Broke with the rib upwards.		
Weight in lbs.	Deflection in inches.	Set, or deflection when unloaded.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
16	.033	visible	30	.061	visible	16	.034	doubtful	112	.03	..	112	.03	..	112	.19	..	112	.21	
30	.062	increased	37	.076	increased	23	.049	visible	224	.07	..	224	.07	..	126	.21	..	168	.30	.01
56	.12	.002	56	.115	.001?	56	.116	.005	336	.11	..	336	.11	..	140	.26	..	224	.40	.025
112	.24	.007	112	.223	.002	112	.228	.008	392	.13	.005	448	.15	..	154	.27	.01	280	.50	.03
168	.37	.014	168	.358	.011	168	.345	.011	420	.14	.007	560	.19	.005	168	.31	.015	336	.60	..
224	.51	.028	224	.49	.019	224	.470	.018	448	.15	.01	616	.21	.01	182	.32	..	392	.71	.06
280	.649	.041	280	.616	.032	280	.599	.030	560	.19	.012	672	.23	..	196	.37	..	448	.82	..
336	.798	.061	336	.757	.05	336	.732	.047	672	.23	.015	728	—	.015	210	.39	..	560	1.09	.15
392	.953	.084	392	.908	.073	392	.878	.069	784	.28	.023	784	.27		224	.43	.03	672	1.39	.26
448	1.12	.12	448	1.068	.101	448	1.030	.095	896	.33	.03	896	.31		238	.46	..	784	1.76	.44
504	1.31	.17	504	1.252	.147	476	broke		952	.35		1008	.35		252	.50	.045	896	2.30	
514	it bore		532	it bore					980	broke		1120	.39		266	broke		1008	2.95	
518	broke		539	broke								1344	.48					1036	3.15	
												1568	.57					1050	broke	
												1792	.67							
												2016	.80							
												2240	.95							
												2295	it bore							
												2352	broke							
Ultimate deflection = 1.36. Broke ¼ of an inch from the centre.			Ultimate deflection = 1,367.			Ultimate Deflection = 1.106			Ultimate deflection = .35.			Ultimate deflection = 1.01. Fracture by a wedge breaking out as in ex. 5 Hot Blast.			Ultimate deflection = .53.			Ultimate deflection = [illegible] Broke by the [illegible] of a wedge as in ex. 7 Hot Blast.		

TABLE II, continued.

Ex. 8.—Bar, whose section was an isosceles triangle, filed to a gauge same as in experiment 8 and 9 Hot Blast. Broke with vertex downwards.			Ex. 9.—Bar same as the last except its having 1-10th taken off the vertex, as in experiment 10 Hot Blast. Broke with the vertex downwards.			Ex. 10.—Bar cast 1¼ inch square, and reduced in the middle to 1.020 deep 1.020 broad.			Ex. 11.—Bar cast the same as the last, and reduced in the middle to 1.014 deep 1.014 broad.			Ex. 12.—Bar a rectangle 3·00 deep, 1·02 broad. Weight 46 lbs. 8 oz.			Ex. 13.—Bar a rectangle 4.98 deep, 1.03 broad. Weight, 78 lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	.07	...	112	.07	...	98	...	.003	98	...	.005	1082	.091	.003	4936	.110	.013
168	.105	.005	168	.11	...	112	...	.003	112	...	.005	1343	.111	.006	5867	.130	..
196	.120	.009	196	.125	...	140	...	.01	140	...	.01	1605	.138	.008	6798	.153	.02
224	.145	...	224	.15	...	168	...	.02	168	...	.02	1866	.164	.010	7730	.179	.025
280	.18	.01	238	—	.002	196	...	.03	196	...	.03	2126	.190	.012	8662	.195	..
336	.22	...	252	.165	.002	224	...	.04	224	...	.04	2388	.220	.015	9593	.219	.034
392	.26	...	280	.19	.002	336	...	.09	336	...	.13	2649	.250	.019	10525	.250	.042
448	.31	...	336	.23	.003	392	...	.13	392	...	.16	2910	.281	.026	10588	broke.	
504	.36	...	392	.27	...	448	...	.19	448	...	.25	3172	.310	.031			
560	.41	.04	448	.32	.01	476	broke.		476	broke.		3433	.345	.037			
616	.45		504	.36	...							3694	.378	.046			
672	.51		560	.42	.025							3825	broke.				
728	.56		616	.47													
784	.62		644	.50													
815	broke.		677	broke.													
∵ Ultimate deflection = .65.			∵ Ultimate deflection = .53.									∵ Ultimate deflection = .395.			∴ Ultimate deflection = .252.		

NOTE.—The dimensions of the bars in Experiments 6 and 7 were very nearly the same as those given in the note to the same experiments on the Hot Blast Iron. In these the thickness of the vertical rib was ¼ inch, and its depth 1 inch; the whole depth of the casting being 1.27. In Experiments 4 and 5 above, the area of a section of the casting was the same as in the others just mentioned, and the thickness of the parts nearly the same, but the vertical rib was of double the depth, or about 2 inches deep; the whole depth being about 2.27 or a little more. This rib, however, was slightly tapered towards the ends, and therefore the results from these experiments were not strictly comparable with those from the others.

Results of the Rectangular Bars above reduced to those of Bars 1 inch broad, and 1, 3, and 5 inches deep. Distance between supports 4 feet 6 inches.

	Specific gravity.	Modulus of elasticity.	Breaking weight in lbs. (*b*).	Ultimate deflection in inches (*d*).	Product *b* x *d* or power of resisting impact.
Experiment 1st bar one inch deep and one inch broad . .	7087	17025000	492	1·394	686
Do 2nd, do do	7082	17516000	509	1·396	711
Do 3rd, do do			429	1·150	493
	Mean	17270500	476	1·313	630
Do 10th, do do	7139 7017		449		
Do 11th, do do	7008		457		
Mean	7066		453		
Do 12th, three inches do			3750	3·95	1481
Do 13th, five inches do			10362	2·51	2601
Results of Experiments not reduced.					
Experiment 6th, bar-rib extended			266	·53	141
Do 7th, do. do. compressed			1050	3·23	3391
Do 8th, Triangle			815	·65	530
Do 9th, Frustum of do.			677	·53	359

Note.—I have been favored by Mr. Fairbairn with the annexed examination of the structure of this and the following Irons:—

"The Carron No. 2, cold blast iron, when viewed with the microscope, presents a dull grey color, finely granulated, with an appearance of greater porosity in the centre than round the extreme edges of the fracture. It is a free working iron, easily cut with the turning tool, but indicates stiffness under the file.

"Carron No. 2, hot blast. This iron has nearly the same character in its working properties as the above; it files with rather more freedom, and possesses an appearance of greater fluidity than the cold blast. Color, a greyish blue, accompanied with a greater degree of uniformity in its crystaline structure than the cold blast.

"Buffery No. 1, cold blast, is finer grained than either of the Carron irons. It is chiefly composed of minute granules intermixed with small brown specks; it works with less freedom than the hot blast, and cuts with difficulty under the tool. In this respect it is much akin to the Milton iron (described in Mr. Fairbairn's paper.)

"Buffery No. 1, hot blast, has a similar appearance to the Carron, No. 2, cold blast; it has more lustre than Buffery No. 1, cold blast; the crystals are widely separated in the centre, but more compact as they approach the outer edge of the bar,

"This appearance is nearly peculiar to the whole of the hot blast irons."

Remarks upon the Experiments in the preceding Tables.—In devising the preceding experiments the writer had several objects in view, which he will now proceed to state. It has been remarked above that the first five experiments on the hot blast iron, and the first three on the cold blast, in the tables above, were made after the others. These will therefore be passed over for the present, and we shall commence with experiments 6 and 7, which, like most of the others, are on bars from the same model in both tables. The object of these experiments was to show the influence of form of section in beams of cast iron; and it will be seen from the results, that when the rib was downwards, the casting broke with 280 lbs. in the hot blast iron, and 266 lbs. in the cold blast. When the rib was upwards, the breaking weights were 980 lbs. and 1050 lbs. respectively; the bars bearing nearly four times as much one way up as the other. These results are contrary to the opinions of some leading writers, as Tredgold and others, who, from their principles, would maintain that the strength should be equal in the two cases. An experiment of this kind I gave in a paper on the strength and best forms of iron beams (Memoirs of the Literary and Philosophical Society of Manchester, vol. v.,) and it formed indeed the basis of the inquiry in that paper.

I had remarked in some of the experiments upon the Carron iron, and more particularly the Buffery following, that the elasticity of the bars was injured much earlier than is generally conceived; and that instead of its remaining perfect till one-third, or upwards, of the breaking weight was laid on, as is generally admitted by writers (Tredgold on Cast Iron, Article 59, &c.,) it was evident that 1-5th or less produced in some cases a considerable set, or defect of elasticity; and judging from its slow increase afterwards, I was persuaded that it had not come on by any sudden change, but had existed, though in a less degree, from a very early period. I mentioned the fact and my convictions sometime after to Mr. Fairbairn, and expressed a desire to have bars cast of greater length than before to render the defect more obvious.

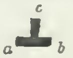
All the future experiments on a transverse strain, whether made by myself or Mr. Fairbairn, have tended to prove the matter.

We passed over the experiments placed at the beginning of Tables I. and II: referring now to them, it will be seen, that in 3 out of 6 experiments, 16 lbs. produced a visible set, whilst the breaking weights in these cases were 469, 462, 518: in other words, the elasticity was injured with 1-30 of the breaking weight, or less. In experiments 4 and 5, Table I., which were on longer bars than the others, cast for this purpose, and for another mentioned further on, the elasticity in the former experiments was sensibly injured with 7 lbs., and in the latter with 14 lbs., the breaking weights being 364 lbs. and 1120 lbs. In the former of these cases a set was visible with 1-52, and in the other with 1-80 of the breaking weight, showing that there is no weight, however small, that will not injure the elasticity.

In two other bars, from the same model, which were laid against vertical supports at the same distance asunder as before, the force being applied horizontally by means of a pulley, 7 lbs. showed a defect of elasticity in that which had the rib submitted to tension, and 21 in the other.

The mode used to observe when the elastic force became injured was as follows. When a bar was laid upon the supports for experiment, a "straight edge" was placed over it, the ends of which rested upon the bar directly over the points of support. These ends were slides which enabled the straight edge to be raised or lowered at pleasure. In this manner it was easy to bring it down to touch in the slightest manner a piece of wood tied upon the middle of the bar. A candle was then placed at the side of the bar opposite to where the observer stood, by the light of which, distances extremely minute could be observed. Should it be asked why this had not been noticed before, the answer of the writer would be, that most experimenters have used bars shorter in proportion to their depth than are here employed, and therefore the set was much less obvious than here; and in deep bars or beams it is almost imperceptible till the weight laid on is considerable.

From what has been stated above, deduced from experiments made with great care, it is evident that the maxim of loading bodies within the elastic limit has no foundation in nature: but it will be considered as a compensating fact, that materials will bear for an indefinite time a much greater load than has hitherto been conceived.

When a body is subjected to a transverse strain, some of its particles are extended and others compressed; I was desirous to ascertain whether the above defect in elasticity arose from tension or compression, or both. Experiments 4 and 5 show this: in these a section of the casting, which was uniform throughout, was the form  . During the experiments the broad flat part *a b* was laid horizontally upon supports; the vertical rib *c* in the latter experiment being upwards, in the former downwards. When it was downwards the rib was extended, when upwards the rib was compressed. In both cases the part *a b* was the fulcrum; it was thin and therefore easily flexible, but its breadth was such that it was nearly inextensible and incompressible comparatively with the vertical rib. We may therefore assume that nearly the whole flexure which takes place in a bar of this form arises from the extension or compression of the rib, according as it is downwards or upwards. In experiment 4 we have extension nearly without compression, and in experiment 5 compression almost without extension. These experiments were made with great care, and their results are generally in accordance with those from two others alluded to above, but not inserted. They show that there is but little difference in the quantity of the set, whether it arises from tension or compression.

The set from compression however is usually somewhat less than that from extension, as is seen in the commencement of the two experiments, and near the time of fracture, in that submitted to tension. The deflections from equal weights are nearly the same, whether the rib be extended or compressed, (as was shown by Duleau in experiments upon triangular bars of malleable iron,) but the ultimate strengths, as appears from above, are widely different.

It is to be hoped that the observations made above will obviate objections which have been offered against a form of cast iron beam arrived at by the writer, in a paper alluded to above. From this paper it appeared that a beam bore the greatest weight from the same quantity of metal when the strengths of its bottom and top ribs were as 6 or 6½ to 1, and this was found in the subsequent experiments of the writer to be nearly the ratio of the tensile to the compressive strength of the iron.

To ascertain the correctness or otherwise of the assertion of Emerson, so often shown to be true in theory, that if a small portion be taken from the vertex of a beam whose section is a triangle, the part will be stronger than the whole, castings were formed both from the hot and cold blast iron (experiments 8, 9, 10, in the one, and 8, 9, in the other.) They were all from the same model and ground to the exact size, and the part taken off in the frustums was $\frac{1}{10}$th of the whole height of the triangle. The breaking weights of the whole triangle, in the hot blast iron were 672 and 812 lbs., mean 742 lbs. and of the frustum 728 lbs. In the cold blast iron the whole triangle was broken with 815 lbs., and the frustum with 677. The difference in the transverse strengths of the hot and cold blast Carron irons, No. 2, is very small, the ratio between them being 99 to 100. (See recapitulation at the close of this report.) We may therefore assume their strengths to be the same, and taking an arithmetic mean between all the strengths we have strength of triangle 766 lbs., strength of frustum 702 lbs. The frustum is therefore weaker than the triangle.

It is often asserted by practical men that if the hard skin at the outside of a cast iron bar be removed, its strength, comparatively with its dimensions, will be much reduced; to try this, four bars, 1¼ inch square each, were made, two of hot and two of cold blast; they were then planed in the middle to one inch square nearly: their results are in experiments 11 and 12 in Table I, and 10 and 11 in Table II. Their strengths were fully equal to those of bars one inch square, which were cast with them but not inserted.

It is generally admitted that the strength of a rectangular beam, whose length and breadth are given, is as the square of the depth. To ascertain how far this important law agrees with experiment, castings were formed both in the Carron and Devon irons; they were 1 inch broad, and had their depths 1, 3, and 5 inches, the distance between the two supports being as usual, 4 feet 6 inches. It is evident then, that if the strength of each of these beams, when reduced to the exact size, be divided by the square of the depth, the quotient should be the same in each case. Hence, taking the mean reduced strength of the 1-inch bars for the first number in each iron, the reduced strength of the 3-inch bars divided by 9 for the second number, and the reduced strength of the 5-inch bars divided by 25 for the third number, we have

In Carron, No. 2, hot blast . . .	452	427	402
Do. cold blast . . .	453	417	514
In Devon Iron, No. 3, hot blast . .	537	576	617
Do. cold blast . . .	448	377	405
	472	449	459

If we compare the numbers in each line, they differ widely; but taking the mean, they approach nearly to equality. We may therefore admit that the strength is as the square of the depth.

TABLE III.

Results of Experiments made to ascertain the Transverse Strength of Devon Iron, No. 3. All the castings were run 5 feet long, as before; they were uniform throughout, and supported on props 4 feet 6 inches asunder. Devon Iron, No 3, made with *Coal* and a Hot Blast.

Experiment 1. Depth of bar 1.00 Breadth of do. 1.00			Experiment 2. Depth of bar 1.09 Breadth of do. 1.01			Experiment 3. Depth of bar 1.50 Breadth of do. 1.50			Experiment 4. Depth of bar 3.00 Breadth of do. 1.03 Weight of do. 18 lbs.			Experiment 5. Depth of bar 1.98 Breadth of do. 1.03 Weight of do. 80¼ lbs.			Ex. 6.—Uniform beam 5.15 in. deep, with ribs top and bottom, of transverse areas, as 1 : 6½. Weight of beam 98 lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	.20		112	.185		112	.04		896	.068	.002	5402	.089	.002	5867	.05	
168	.30	.002	168	.29		224	.08		1008	.073	.003	5867	.10	.002	6798	.058	
224	.41	.01	224	.40	.007	336	.12		1082	.077	.004	6798	.117		7730	.06	
280	.51		280	.50		448	.17		1306	.094	.004	7730	.135	.008	8196	.07	.002
336	.62	.02	336	.61	.020	560	.22	.005	1530	.108	.005	8662	.153		8662	.074	.004
392	.73	.03	392	.73		672	.26		1754	.125	.008	9593	.17	.015	9593	.08	.004
448	.84	.04	448	.85	.05	784	.31		1978	.147	.010	10524	.19		10646	.093	.008
476	.90		504	.99		896	.36		2202	.162	.012	11950	.22		12751	.108	.01
504	.97		560	1.14		1008	.42		2426	.180	.014	14190	.28		14857	.130	
			574	1.17		1120	.47	.035	2650	.200	.017	15758	broke		16963	.150	.011
			588	broke		1232	.52		2874	.218	.019				19068	.17	.014
						1344	.58		3098	.240	.024				20121	.18	
						1456	.64		3322	.261	.026				21174	.195	
						1568	.71		3546	.286	.029				25817	broke	
						1680	.79		3770	.310	.032						
						1792	.85		3994	.333	.040						
						1904	.96		4218	.360	.047						
						2016	1.05		4442	.388	.055						
						2118	1.16		4666	.420	.067						
						2184	broke		4890	.450	.081						
									5114	.495	.100						
									5338	.530	broke						
Broke in half a minute one inch from the middle.			∴ Ultimate deflection=1.20.			∴ Ultimate deflection=1.21.			Broke in about a minute.			∴ Ultimate deflection=.32			Broke by tension, or tearing the lower rib asunder.		

Table IV.

Devon Iron, No. 3, made with *Coke* and a Cold Blast. Distance between the supports as before.

Exp. 1. Depth of bar 1·00 Breadth of do. 1·00			Exp. 2. Depth of bar 1·00 Breadth of do. 1·00			Exp. 3. Depth of bar 1·48 Breadth of do. 1·49			Exp. 4. Depth of bar 1·50 Breadth of do. 1·50			Exp. 5. Depth of bar 2·97 Breadth of do. 1·00 Weight of do. 44½ lbs.			Exp. 6. Depth of bar 4·98 Breadth of do. 1·01 Weight of do. 77½ lbs.			Ex. 7.—Uniform beam 5·13 inches deep, from same model as that in Exper. 6, Hot Blast, Weight of bar, 91½ lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	·19		112	·195		336	·13		336	·13		1120	·083	+	4936	·08		4936	·058	
168	·29		168	·295		448	·17		392	·156	·004	1232	·100	.003	5402	·089	·005	5867	·070	
224	·39		224	·40		504	·20	·003	448	·18	·01	1306	·097		5867	·097	·007	6798	·083	
280	·49		252	·45	·002	560	·22	·005	560	·23	·01	1530	·113	.003	6333	·105		726	·090	·002
336	·59	·001	280	.50	·005	672	·27		672	·27		1754	·132	·004	6798	·11		7730	·096	·004
364	·64	·002	336	·59		784	·31		784	·32		1978	·151	·004	7264	·117		9593	·120	·007
392	·68		392	·70	·01	896	·36		896	·37		2202	·168	·006	7730	·127	·01	10646	·135	
420	·73		420	·75		1008	·41		1008	·42		2426	·189	·007	8662	·138	·011	12751	·167	·013
448	broke.		448	·80		1120	·46	·015	1120	·47	·02	2650	·207	·008	9593	·157	·012	14857	·202	·018
						1232	·51		1232	·52		2874	·227		10152	broke.		16963	·240	·030
						1288	·53		1288	·55		3098	·248	·01				19068	·275	·048
									1344	broke.		3322	broke.					21174	·325	·07
																		22227	broke.	
∵ Ultimate deflection = ·78.			Broke in ½ a minute after the weight 448 lbs. had been put on again.			Broke in half a minute after loading.			∵ Ultimate deflection = 58.			∵ Ultimate deflection = ·269.			∵ Ultimate deflection = ·168.			Broke by tension on the bottom rib being torn asunder.		

Results of TABLE III. *reduced to those of Bars* 1 *inch broad, and* 1, 1½, 3, *and* 5 *inches deep.*

	Specific gravity.	Breaking weight in lbs. (*b*).	Ultimate deflection in inches (*d*).	Product *b*+*d*. or power of resisting impact.	Modulus of elasticity in lbs. for a base of 1 in square.
Experiment 1st, bar 1 inch deep, 4 feet 6 inches span	7251	504	·97	488·8	22,044,900
Experiment 2nd, bar 1 inch deep, do. do.	. . .	570	1.21	689·7	22,902,400
Mean	. . .	537	1·09	589·2	22,473,650
Experiment 3rd, bar 1½ inch deep, do. do.	. . .	1456	1.21	1761·7	
Experiment 4th, bar 3 inches deep, do. do.	. . .	5183	·53	2747	
Experiment 5th, bar 5 inches deep, do. do.	. . .	15422	·32	4935	

Results of TABLE IV. *reduced to those of Bars* 1 *inch broad, and* 1, 1½, 3, *and* 5 *inches deep.*

	Specific gravity.	Breaking weight in lbs. (*b*).	Ultimate deflection in inches (*d*).	Product *b*+*d*. or power of resisting impact.	Modulus of elasticity in lbs. for a base of 1 in. square.
Experiment 1st, bar 1 inch deep, and 4 feet 6 in. span	7306	448	·78	349·4	23.205.200
Experiment 2nd, bar 1 inch deep, do. do.	7285	448	·80	358·4	22.610.200
Mean	. . .	448	·79	353·9	22.907.700
Experiment 3rd, bar 1½ inch deep, do. do.	7340	888	·54	479·5	
Experiment 4th, bar 1½ inch deep, do. do.	7251	892	·56	499·5	
Mean	7295	890	·55	489·5	
Experiment 5th, bar 3 inches deep, do. do.	. . .	3389	·272	921·8	
Experiment 6th, bar 5 inches deep, do. do.	. . .	10133	·168	1702·3	

The last experiment in both the preceding tables was upon a beam of the best form of section, according to the writer's experiments, (Manchester Memoirs, vol. 5.) the top and bottom rib being nearly in the ratio of the tensile to the compressive forces of the metal, as mentioned above. The intention was to compare the strength of the beam with that of a rectangular one of the same weight, length, and depth. For this purpose the beams were cast uniform throughout, and in comparing the strength of that in the hot blast iron with the mean from the strengths of the two preceding rectangular beams, reduced as above, we find that the breaking weight of these is 19,108 lbs., and the beam of best form was broke with 25,817 lbs. In the cold blast Devon iron, the difference in strength is much greater. The rectangular beam, from the mean of the two experiments on the beams 3 inches and 5 inches deep, when reduced as above, gives 11,183 lbs. for the breaking weight, whilst the beam of the best form required 22,227 lbs. to break it.

Table V.—Results of Experiments to determine the transverse strength of rectangular bars of iron of the quality No. 1, from the Buffery Iron Works, near Birmingham.

All the specimens were cast 5 feet long, and supported upon props 4 feet 6 inches asunder.

Hot Blast Iron.

Ex.p 1. Depth of bar 1·005 Breadth of do. 1·030 Weight of do. 15 lbs. 13 oz.			Exp. 2. Depth of bar 1·000 Breadth of do. 1·010 Weight of do. 15 lbs. 7 oz.			Exp. 3. Depth of bar 1·000 Breadth of do. 1·010 Weight of do. 15 lbs. 4 oz.			Exp. 4. Depth of bar 2.000 Breadth of do. 1.970 Weight of do. 60 lbs. 6 oz.			Exp. 5. Depth of bar 2·000 Breadth of do. 1·980 Weight of do. 60 lbs.		
Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.	Weight in lbs.	Deflection in inches.	Set.
112	·310	—	112	·315	·018	112	·322	·010	1082	·210	·015	1082	·217	·028
224	·680	·037	224	·660	·045	224	·720	·055	1306	·257	·020	1306	·270	·031
336	1·140	·100	336	1·110	·120	336	1·200	·128	1754	·368	·035	1754	·380	·045
392	1·410	—	392	1·360	·170	392	1·490	·210	2202	·495	·060	2202	·510	·075
448	1·710	·254	441	broke.		413	broke.		2650	·639	·100	2650	·862	·117
483	broke.								2874	·720	·122	2874	broke.	
									2930	broke.				
∵ Ultimate deflection = 1 840			∵ Ultimate deflection = 1·530			∵ Ultimate deflection = 1·570			∴ Ultimate deflection = ·740			∴ Ultimate deflection = ·732		

Results reduced to those of bars 1·000 and 2·000 inch square.

	Specific gravity.	Breaking weight in lbs. (b).	Ultimate deflection in inches (d).	Product $b \times d$, or power of resisting impact.	Modulus of elasticity in lbs. for a base of 1 in. square.
Ex. 1st, bar 1 in. square 4 feet 6 in. span	6938	464	1·84	853·76	13603000
Ex. 2nd, bar 1 in. square, do. do.	7050	437	1·53	668·61	13858000
Ex. 3rd, bar 1 in. square, do. do.	7008	409	1·57	642·13	
Mean	6998	436	1·64	721·50	13730500
Ex. 4th, bar 2 in. square, do. do.	. . .	2975	·740	2201·500	
Ex. 5th, bar 2 in. square, do. do.	. . .	2903	·732	2124·996	
Mean	. . .	2939	·736	2163·248	

TABLE VI.—Results of Experiments on rectangular bars of Buffery Iron, No. 1, continued.

Cold Blast Iron.

Experiment 1.
Depth of bar 1·004
Breadth of do. ·900
Weight of do. 15 lbs. 3 oz.

Weight in lbs.	Deflection in inches.	Set.
105	—	·010
112	·28	·011
224	·612	·050
336	1·00	·105
392	1·22	·150
448	1·46	·210
490	broke.	

∴ Ultimate deflection = 1·60.

Experiment 2.
Depth of bar 1·013
Breadth of do. 1·014
Weight of do. 15 lbs. 7 oz.

Weight in lbs.	Deflection in inches.	Set.
105	—	·005
112	·278	·008
224	·587	·036
336	·953	·083
448	1·39	·170
455	broke.	

∴ Ultimate deflection = ·141.

Experiment 3.
Depth of bar 1·010
Breadth of do. 125·
Weight of do. 15 lbs. 15 oz.

Weight in lbs.	Deflection in inches.	Set.
86	—	—
93	—	·003
112	·275	·006
224	·610	·016
336	1·00	·100
392	1·23	·150
448	1·49	·217
483	broke.	

∴ Ultimate deflection = 1·61.

Experiment 4.
Depth of bar 2·00
Breadth of do. 1·99
Weight of do. 61 lbs.

Weight in lbs.	Deflection in inches.	Set.
1082	·185	·014
1306	·235	·020
2754	·332	·036
2202	·44	·055
2650	·56	·08
2874	·629	·10
3042	broke.	

∴ Ultimate deflection= 6·74.

Experiment 5.
Depth of bar 1·98
Breadth of do. 1·98
Weight of do. 60½ lbs.

Weight in lbs.	Defloi-tion n inches.	Set.
1082	·187	·017
1306	·23	·02
1754	·338	·037
2202	·435	·058
2950	·55	·084
2874	·617	·100
3098	·69	·123
3322	·774	·15

Broke in about a minute after the weight 3322 lbs. had been put on.

Results reduced to those of bars 1·000 and 2·000 inch square.

	Specific gravity.	Breaking weights in lbs. (*b*).	Ultimate deflection in inches (*d*).	Product $b \times d$, or power of resisting impact.	Modulus of elasticity in lbs. for a base of 1 in. square.
Ex. 1st, bar 1 in. square, 4 feet 6 in. span	7086	491	1·60	785·60	15716100
Ex. 2nd, bar 1 in. square, do. do.	7090	437	1·43	624·91	15046300
Ex. 3rd, bar 1 in. square, do. do.	7061	462	1·63	753·06	
Mean	7079	463	1·55	721·19	15381200
Ex. 4th, bar 2 in. square, do. do.	. . .	3057	·674	2060·418	
Ex. 5th, bar 2 in. square, do. do.	. . .	3424	·766	2622 784	
Mean	. . .	3240	·720	2341·601	

General Abstract of Transverse Strengths.

In the following abstract the transverse strengths of hot and cold blast irons to bear pressure and impact will be given, together with the ratio of these strengths.

The comparison will be made between the results of bars from the same models, taking the reduced results, where such reduction has been made.

Carron Iron No. 2.

	Strength of Irons.			Power to bear impact.		
	Cold Blast Iron.	Hot Blast Iron.	Ratio of strengths. The strength of Cold Blast Iron being represented as 1000.	Cold Blast Iron.	Hot Blast Iron.	Ratio. The power of Cold Blast being represented as 1000.
Results reduced.	492	469	1000 : 953·2	686	677·2	1000 : 987·1
	509	456	1000 : 895·8	711	649·3	1000 : 913·2
	429	465	1000 : 1083·9	493	532·0	1000 : 1079·1
	449	475	1000 : 1057·9	1481	1598·7	1000 : 1079·4
	457	429	1000 : 938·7	2601	2744·2	1000 : 1055.0
	3750	3843	1000 : 1024·8	141	154	1000 : 1092·2
	10362	10957 9149 10053	1000 : 970·1	3391	3087	1000 : 910·3
				530	452	1000 : 852·8
				359	458·6	1000 1277·4
		Mean	1000 : 989·1			
					Mean	1000 : 1005·1
Results not reduced.	266	280	1000 : 1052·6			
	1050	980	1000 : 933·3			
	815	672 817 742	1000 : 910·4			
	677	728	1000 : 1075·0			
		Mean	1000 : 992·8			
		General Mean	1000 : 990·9			
Devon No. 3 Iron.						
	448	504	1000 : 1125·0	353·9	589·2	1000 : 1664·8
	448	570	1000 : 1272·3	489·5	1761·7	1000 : 3598·9
	890	1456	1000 : 1635·9	921·8	2747	1000 : 2980·0
				1702·3	4935	1000 : 2899·0
	3389	5183	1000 : 1529·3			
	10133	15422	1000 : 1521·9		Mean	1000 : 2785·6
		Mean	1000 : 1416·9			
Buffery No. 1 Iron.						
	491	464	1000 : 945·0	721·19	721·5	1000 : 1000·4
	437	437	1000 : 1000·0	2341·6	2163·2	1000 : 923·8
	462	409	1000 : 885·7			
	3057	2975	1900 : 973·1		Mean	1000 . 962·1
	3424	2903	1000 : 850·1			
		Mean	1000 : 930·7			

Having now subjected the irons which are tried in this paper to a variety of strains, and given the results under their proper heads; a summary of the whole will be added, with remarks to show the general bearing upon the question of Hot and Cold Blast Iron.

Recapitulation.

Taking only the means from all the experiments in the present paper, and attaching to each value a number, in a parenthesis, indicative of the quantity of experiments from which it has been derived, we have as below:

Carron Iron No. 2.

	Cold Blast.	Hot Blast.	Ratio representing Cold Blast by 1000.	
Tensile strength in lbs. per square inch.	16683(2)	13505(3)	1000 : 809	
Compressive strength in lbs. per inch from castings torn asunder,	106375(3)	108540(2)	1000 : 1020	Mean 997
Do. from prisms of various forms,	100631(4)	100738(2)	1000 : 1001	
Do. from cylinders,	125403(13)	121685(13)	1000 : 970	
Transverse strength from all the experiments,	(11)	(13)	1000 : 991	
Power to resist impact,	(9)	(9)	1000 : 1005	
Transverse strength of bars one inch square in lbs.,	476(3)	463(3)	1000 : 973	
Ultimate deflection of do. in inches,	1.313(3)	1.337(3)	1000 : 1018	
Modulus of elasticity in lbs. per square inch,	17270500(2)	16085000(2)	1000 : 931	
Specific gravity,	7066	7046	1000 : 997	

Devon Iron No. 3.

	Cold Blast.	Hot Blast.	Ratio representing Cold Blast by 1000.
Tensile strength,		21907(1)	
Compressive strength,		145435(4)	
Transverse do. from the experiments generally,	(5)	(5)	1000 : 1417
Power to resist impact,	(4)	(4)	1000 : 2786
Transverse strength of bars one inch square,	448(2)	537(2)	1000 : 1199
Ultimate deflection do.,	.79(2)	1.09(2)	1000 : 1380
Modulus of elasticity do.,	22907700(2)	22473650(2)	1000 : 981
Specific gravity,	7295(4)	7229(2)	1000 : 991

Buffery Iron No. 1.

	Cold Blast.	Hot Blast.	Ratio representing Cold Blast by 1000.
Tensile strength,	17466(1)	13434(1)	1000 : 769
Compressive do.	93366(4)	86397(4)	1000 : 925
Tranverse do.,	(5)	(5)	1000 : 931
Power to resist impact,	(2)	(2)	1000 : 963
Transverse strength of bars one inch square,	463(3)	436(3)	1000 : 942
Ultimate deflection do.,	1.55(3)	1.64(3)	1000 : 1058
Modulus of elasticity do.,	15381200(2)	13730500(2)	1000 : 893
Specific gravity,	7079	6998	1000 : 989

Coed-Talon Iron No. 2.

	Cold Blast.	Hot Blast.	Ratio representing Cold Blast by 1000.
Tensile strength,	18855(2)	16676(2)	1000 : 884
Compressive do.,	81770(4)	82739(4)	1000 : 1012
Specific gravity,	6955(4)	6968(3)	1000 : 1002

Carron Iron No. 3.

	Cold Blast.	Hot Blast.	Ratio representing Cold Blast by 1000.
Tensile strength,	14200(2)	17755(2)	1000 : 1250
Compresive do.,	115442(4)	133440(3)	1000 : 1156
Specific gravity,	7135(1)	7056(1)	1000 : 989

Of the three columns of numbers in the table above, the first is the strength, or other quality, in the cold blast iron; the second is that in the hot blast; and the third is the ratio of these quantities.

The results in this table contain nearly the whole information relative to the question of hot and cold blast iron that the preceding research affords; and before adverting to them it may be mentioned that it is usual for the makers of cast-iron to divide it, when taken from the furnace, into three classes, called Nos. 1, 2, 3, differing from each other in the appearance and qualities of the material. No. 1 contains the softest and richest irons, those which have the largest crystals; No. 3, the hardest and densest irons, those with the least crystals; and No. 2, irons intermediate between the former two descriptions. Beginning with the No. 1 iron, of which we have a specimen from the Buffery Iron Works, a few miles from Birmingham, we find the cold blast iron somewhat surpassing the hot blast in all the following particulars—-direct tensile strength, compressive strength, transverse strength, power to resist impact, modulus of elasticity or of stiffness, specific gravity; whilst the only numerical advantage possessed by the hot blast iron is that it bends a little more than the cold blast before it breaks.

In the irons of the quality No. 2 the case seems in some degree different; in these the advantages of the rival kinds seem to be more nearly balanced. They are still, however, rather in favour of the cold blast.

Referring to the No. 2 iron, from the Carron Works in Scotland, we find the tensile, compressive, and transverse, strengths, together with the modulus of elasticity and specific gravity, all higher in the cold blast iron than in the hot blast, whilst the ultimate deflection and power of sustaining impact are greater in the hot blast. The cold blast iron is the better, but the difference is very small.

In the iron No. 2, from the Coed-Talon Works in North Wales, the tensile strength is greater in the cold blast than in the hot; but the resistance to compression is higher in the latter than the former, and that is the case with the specific gravity.

So far as my experiments have proceeded, the irons of No. 1 have been deteriorated by the hot blast; those of No. 2 appear also to have been slightly injured by it, whilst the irons of No. 3 seem to have benefitted by its mollifying powers. The Carron iron No. 3, hot blast, resists both tension and compression with considerably more energy than that made with the cold blast; and the No. 3 hot blast iron from the Devon Works, in Scotland, is one of the strongest cast-irons I have seen, whilst that made with the cold blast is comparatively weak, though its specific gravity is very high, and higher than in the hot. The extreme hardness of the cold blast Devon iron above, prevented many experiments that would otherwise have been made upon it, no tools being hard enough to form the specimens. The difference of strength in the Devon irons is peculiarly striking.

From the evidence here brought forward, it is rendered exceedingly probable that the introduction of a heated blast into the manufacture of cast iron has injured the softer irons, whilst it has frequently mollified and improved those of a harder nature; and considering the small deterioration that the irons of the quality No. 2 have sustained, and the apparent benefit to those of No. 3, together with the great saving effected by the heated blast, there seems good reason for the process becoming as general as it has done.

Additional evidence will be obtained from the experiments in the next paper.*

Progress of Manufactures on the Continent of Europe.

The following information on the above important subject is extracted from a very able work, entitled "Arts and Artizans at Home and Abroad; with Sketches of the Progress of Foreign Manufactures." By Jelinger Symons, Esq. We would observe, that the statements of this gentleman are entitled to the more attention, from the peculiar facilities he enjoyed of obtaining the most authentic information in his capacity of assistant commissioner of the hand-loom inquiry:—

"Machinery is the main agent for manufactures, and no surer index of the progress of the latter can be adduced than the advances of the former. I am, I confess, not among the number of those who magnify the relative importance of the existing circumstances and extent of foreign competition; but I should be wilfully blind to the plainest evidences of the truth, were I to conceal that there are symptoms throughout the continent of a prospective, and by no means a remote rivalry with this country in the chief of those arts of production and elements of commerce in which England has heretofore maintained a perfect and facile pre-eminence. The peril to this country is to be measured not by present competition, but by the magnitude of the preparations, and the germs of a progress which is, as yet, confined to a promising and vigorous infancy, evidenced chiefly by the rapid increase of machine-making establishments, to a slight description of which I shall devote this chapter. Belgium, from her mineral riches and other topographical facilities, naturally takes the lead in the progress of continental machinery. I have already alluded to the leviathan establishment of Mr. John Cockerill, at Seraing, employing 3000 workmen, with seven skilful English engineers superintending the chief departments, and combining English skill with the advantage of cheap labour. The motive power consists of steam engines of 900 horse power; and Mr. Cockerill not only supplies machinery to all parts of the continent, but has branch establishments in three different countries. In addition to spinning machinery of every description, steam engines, both stationary and locomotive, are supplied to France, Germany, and Russia. It is difficult to name any large enterprise of manufacturing industry, whether in Belgium, Holland, Russia, or the immense territory of the Prussian league, with which Mr. Cockerill is unconnected, either as a shareholder, or as the engineer from whom the machinery emanates. He has spinning mills of flax, or cotton, or wool, in almost all the chief districts for these manufactures in the Prussian and Belgian dominions. Mr. Cockerill's name is on all the locomotive engines on the Belgian rail roads, and I was told that he is the contractor for those now forming in Prussia. When we remember that Mr. Cockerill's father, who established this gigantic concern, came over to Belgium a common blacksmith, and could neither read nor write, I believe, till the day of his death; when we further consider that the machinery he turns out is, after all, of secondary reputation for quality, and extremely dear, we may form some idea of the power and magnitude of the natural advantages Belgium affords to the manufacture of machinery, and which may be reckoned as the multiplier of all her other productive powers. Mr. Cockerill, extensive as are his enterprises, by no means monopolises the making of machinery. Of those now commencing there are the Messrs. Fairbairn, who have issued prospectuses of an establishment which was to be formed at the large factory already built at Malines, near the rail road station. Mr. William Fairbairn is to superintend the heavy department for engines, locomotives, &c., and Mr. Peter Fairbairn that for spinning machinery, and especially for flax spinning. There can be no question that this establishment will rival any in England. In addition to these is the company of the Phœnix, at Gand, on a very large scale, and in which English and Scotch engineers are already engaged. There is likewise another at Brussels, of the existence of which some mystery is made. I owe the knowledge of it to Sir Hamilton Seymour, who kindly accompanied me to see it, and, owing to his good offices, we obtained the unusual favour of being allowed to inspect the interior. It is of large dimensions, covering two bonniers and a half, of about 6500 square feet each. This establishment belongs to one of the *sociétes anonymes*, of which the Banque Nationale is said to be at the head. Five hundred workmen, of nearly all nations except France, whose operatives are not in repute in Belgium, are employed. Some of Sharp and Roberts's machinery was there. The present motive power is not above 36 horse. There are several old established machine makers in different towns in Belgium, but few on the same scale as those I have named. The fact is, that this industry is yet in the first stage only of its development. Mr. Cockerill told Sir Hamilton Seymour that he had all the new inventions over at Seraing ten days after they came out in England. There is but one chance of an obstacle to the career of Belgium in her manufacturing progress of competition with England, and that one her Majesty's government have recently, no doubt with the best intentions, used their best exertions to remove—exertions which have met with the best reception and success on the part of Belgium. I allude to the decreasing stock and increasing price of coal in that country. The following table of its rapid rise in price is extracted from statistical government returns:—

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* The paper of W. Fairbairn, Esq. will be continued in the next number.

	1836.	1837.
Mons	7 and 8 fr. per tonne	12 and 14 fr. per tonne,
Charleroi	13 and 14 fr. do.	18 and 19 fr. do.

Prior to 1836, Mons coal was 8 fr. per tonne at the *maximum*. It has risen in price since last year; and the Belgian government have, consequently, assented to the prayer of the English government, to be allowed to supply them free of duty. By France a similar boon has been granted to the coal owners in England, and I need hardly say that the Belgian and French manufacturers are overjoyed at the concession. The iron works make equal progress in Belgium. In 1837 there were twenty-three high furnaces of coke, and sixty-six of charcoal, in Belgium. Twenty new furnaces of coke are either completed, or being erected since that period. On the plain of Selessin, near Liege, a company are erecting six, of a colossal magnitude, which, when finished, will be the largest on the continent. The quantity of iron founded in the year in Belgium was estimated at 150,000 tonnes (or about 147,640 English tons). It is now increased. The following are the current prices of iron per tonne:—

	Francs First quality.	Francs Second quality.
1830	465	390
1832	412	322
1834	393	304
1836	413	324

"In France machine making is proceeding with considerable rapidity. Mr. Dyer, of Manchester, has established his son at Blangy, not far from Abbeville, and there are many French competitors. There is one, especially, at Rheims, who turns out excellent machinery, and many at St. Etienne. At Zurich, in Switzerland, there is a first rate establishment of this sort, where iron steam boats, down to the finest spinning machinery, are manufactured. There are nearly 700 workmen employed here, and seven are English foremen. Mr. Escher, who is one of the first and most scientific industrialists of the continent, is at the head of this establishment, and, like Mr. Cockerill, is also the proprietor of several flourishing steam factories, some paper mills, some weaving, and some spinning, mills, not only in Switzerland, but in Piedmont, Savoy, the Tyrol, and Wirtemberg, where he is about to erect a flax factory. Mr. Peter Kennedy, late of Manchester, is in partnership with him, and superintends the Austrian mills. New inventions are frequently made. For instance, I saw a roller introduced at the end of the carding frames, round which the cards are wound, and which dispenses entirely with the pans, and, consequently, with a great number of hands, still employed in most, if not in all, of the English mills. Again, they are enabled to unite the separate advantages of different patents in England; and at Mr. Escher's factory, in Zurich, I saw a combination of the self-acting mules severally produced by Sharp and Roberts, and Mr. Smith of Deanston, and which their patents prevent our combining in England. Many of the foreign mechanics, who have not an equal skill in the invention or improvement of machinery, directly pirate the productions of English skill. An English gentleman told me he had assisted in putting together some new machinery in Italy, which had been cast in moulds formed from some smuggled machinery of the Messrs. Crichton, with their name and the word 'Patent' cast on it. At Vienna, the Emperor has a large establishment under his immediate patronage, and an Englishman of the name of Thompson, is one of its chief superintendents. The Emperor of Russia has very large foundries and spinning factories at Alexanderoffsky, with a General Clark at the head of the foundry, and a Mr. Wilson of the factories, and at Colpenny, with several English workmen. Wilson, brother of the above named, is the foreman or superintendent at St. Petersburgh; the foundry is chiefly for cannon. John Isherwood, formerly of Leeds, is at the head of another establishment called Waybugskey, a part of the capital. The following information on the denizen mechanical skill in Poland, is from a perfectly authentic source. A large mill, having sixteen pair of mill-stones, moved by steam power, and lighted with gas, was erected at Warsaw some years ago. It was at first managed by a native of France, under whose management it did not succeed. For the last six years, a Mr. Kedslie, mill factor, from Leith, has been the superintendent, and he has taken out two millers and their families from the mills on the Water of Leith: the mill is now working day and night, and succeeding well. All parties concerned there are said to be much pleased that the bill to grind bonded grain has been thrown out by the British House of Commons. They fear nothing so much as British capital, machinery, and skill to compete with them. John Douglas and nephew, from Edinburgh, established thrashing machines and paper mills in Poland, and have now settled as paper mill proprietors in that country.

"Since the last rebellion in Poland, James Garvie and Son, also Thomas Garvie, shawl manufacturers, from Edinburgh, have succeeded in establishing a shawl manufactory thirty miles from Warsaw, upon the estate of Count Lubenskie, President of the Board of Trade there: the factory consisted of thirty looms in the month of September, 1836. This same Count has erected a spinning mill for flax, 300 feet long, 100 feet wide, three flats in height, and has 200 looms at work, weaving table cloths, towelling, and linens; also thirty shawl looms in the month of September, 1836: the yarn all spun by his own mill. Thomas Garvie has engaged to be his overseer for the weaving department, and left the shawl factory to his brother James and son, who are doing well. Mr. Pritchard, from Edinburgh, now engineer to the government zinc mines in Poland, was in Scotland two years ago, at which time he engaged a bleacher from Perthshire, who has commenced bleaching in the above establishment. This is the first attempt at bleaching in Poland. Mr. George Blackie, engineer from Edinburgh, is now employed on canals and public roads by the Government of Poland. At Prussian Bohemian, at Aix, in Prussia, and in Saxony, at Chemnitz, there are also machine-making establishments. In fact, they are rising in all parts of the continent with a rapidity and to an extent very far disproportioned either to the growth of the population or to the progress of preceding years. English machinery is smuggled abroad in considerable quantities, at a charge of 75 per cent., and sometimes for less. The increase of machine makers abroad, and the emigration of English artisans, will, however, soon tend, unfortunately for us, to diminish this traffic; for the very limited number of machine makers who have, till within the last two years, been established abroad, has hitherto tended to give them monopoly prices. Seeing the utter inefficiency of our laughable prohibition on the exportation of machinery (driven by a screw of an inch and a half diameter), it is much to be lamented that this protection and encouragement, afforded by the smugglers' high per centage, should be given to foreign machine makers, to the manifest injury of that branch of our own industry, without, in the slightest degree, benefiting the factories it is designed to protect. There are few absurdities of our custom house legislation which it is more urgently incumbent on the government to abolish. If a free exportation of foreign machinery were to take place, I have not the slightest doubt that the foreign machine makers would be crippled, and that we should largely increase our own trade in machinery—one, I may be permitted to remark, to which it is the policy of this country to give the fullest scope, as it is manifestly that in which we pre-eminently possess territorial and artistical capacity to excel, far surpassing that of any other nation. However, as long as we protect the machine maker abroad, to the injury of the machine maker at home, we must expect to see a rapid increase of this industry abroad; one, be it ever remembered, which is the prolific parent of every other; and, what is still worse, we must expect to see more of our Dyers, Fairbairns, and Cockerills preparing to follow their predecessors in transferring their skill and capital from the employment of home, to foreign labour. I was debating the proposed imposition of a duty on our flax yarn by the French government, with one of our leading manufacturers of France, Mons. Delasalle, of Lille, 'And how,' said he, 'can your government have the face to talk to us about the impolicy of protecting our home industry, when it goes the tenfold greater length of prohibiting even the exportation of the articles which may indirectly aid the industry of another country? Let England abolish her prohibition on the export of machinery—let her abolish a protecting law of her own, more stringent and illiberal than that of any other nation in Europe, before she talks to us of the benefits of a free trade.' Mons. Delasalle is President of the Chamber of Commerce at Lille, and in constant communication with the government on these subjects. We had a very long discussion on the general policy of free trade. He adheres rigidly to the protective system, but not without many manifest misgivings in his own mind."

Mining Review.

Upon the mode of determining the quantity of Copper in ores and smelting products, by the humid way. By Ch. Kersten, *Professor of Chemistry and Metallurgy in Freyberg.*

The copper assay by the dry way belongs to those operations of assaying from which it is desired that the most true and accurate results may be given, but it proves imperfect in the examination of ores and smelting products, which yield only few per cent. of copper, and which, besides, consist of nickel, cobalt, iron, antimony, and other metals of this kind; therefore, if the question was to learn the real richness of copper in any ore or smelting product, I have always chosen the humid way, and precipitated the copper from the solutions of substances under examination, by employing sulphuretted hydrogen. The sulphuret of copper, it only small quantities of it were obtained, was converted into an oxide by calcination, under the cover of a muffle; if more, then it was digested with aqua regia, and the dissolved oxide of copper was precipitated on introducing caustic hydrate of potass into the heated liquid. But this process is rendered still more complex, should the substance contain lead or silver (without the removal of which from the solution, the precipitation of pure copper cannot possibly take place,) and loses much in accuracy and exactness, should, in addition to the already named metals, antimony and arsenic, be contained in the substances, whose richness in copper is to be determined, as, for instance, in *bleystein*, containing copper and other metals.

The more satisfactory was it, on this account, for me to become acquainted with the process introduced in the laboratory of Mr. Sefstrom, and the Gustav silver smelting house, at Fahlun, for determining the quantity of copper in copper ores, which, from the experimental assays I have since made, proves itself so admirably adapted for the purpose, not only enabling the assayer to find out the quantity of copper contained in ores of poor quality, but also in ascertaining the same, with the greatest ease and accuracy, in copper, scoria, &c. The process consists, in general, of the treatment of the substances containing copper, with concentrated sulphuric acid, and precipitating the solution obtained with metallic iron.

Although it may seem to require but little explanation, the success of an assay will be found to depend much on address, and a strict observance of the rules practice has laid down is strongly to be recommended. I take the liberty, therefore, of communicating the process, which at the present time is adopted in the Metallurgical Laboratory in Freyberg for determining the richness of copper in ores and scoria. In order to obtain an average assay of the ore or product, any discretionary quantity is to be pounded in a mortar, the same as every other copper assay. A small portion of the powder is then again pounded in a mortar of steel or calcedony, and from three to five grammes* taken away and weighed; this powder is now put into a bolt-head, the neck of which must be broken off, having a height of from two and a half to three inches, and then mixed with three-fourths of an ounce of concentrated sulphuric acid. In order to avoid weighing the sulphuric acid, we make use of a pipette, with India rubber. Any number of such bolt-heads are placed in the sand bath, which is filled an inch in depth with sand, and stands either in the open air or in a good draught. The fire under the sand bath is to be gradually increased till the sulphuric acid boils, and till all steam from the sulphuric acid disappears, and the mass has become dry: from six to twelve hours, according to the nature of the substances to be assayed, will be found necessary; into each bolt-head, one then pours twenty drops of sulphuric acid. After half an hour's digestion, the mass in the bolt-head can be poured over with hot boiling water, and then rinsed in a warmed precipitate glass. While the fluid is still hot, filter it likewise in a heated precipitate glass, and pour boiling water on the insoluble sediment till the whole solution amounts to 2 lbs. The precipitation of copper now takes place. We make use of an iron or steel plate, from eight to nine inches long, filed square, and about a quarter of an inch thick; on this occasion, however, before employing the same, it must be wrapped up in paper and laid in the sand bath to get hot. As soon as the hot copper solution is stirred with the bar, a strong ebullition of the hydrogen gas follows, and metallic copper will be precipitated. During the precipitation one must cover the precipitate vessel with a plate of glass. If no more hydrogen gas is evolved, and the previous greenish blue solution has become colourless, which generally takes place in one hour to one and a half, the precipitation which must take place in the sand bath is completed. If the fluid has been properly thinned, and reddened the litmus paper, and is hot, no copper generally will be found attached to the iron bar, it having detached itself and fallen to the bottom of the precipitate glass. The iron appears, as far as it has been immersed in water, to have covered itself with a thin coat of carbon. We transfer the same with a camel-hair brush into the liquid, and after washing it in this manner, dry, and quickly polish it with a fine file. The liquid is now decanted from the precipitate glass in which the copper lies, as long as the same can be managed without loss, and the precipitate glass is again filled with hot water, till the copper, by this process, has become quite pure. Through repeated decantation all particles of carbon which have loosened themselves from the iron plate during the precipitation of the copper will be entirely separated from the last, and appear as a uniform powder, of a beautiful red copper colour. After the last cleaning of the filter, we brush the copper with a fine camel-hair brush, or the beard of a quill, into a prepared filter, dry the same at 100 degrees, and determine the weight of the metal. With small quantities of copper, instead of filtering, I wash it in a previously weighed watch glass, drawing off the small quantity of water by a pipette. I let the rest evaporate, and then weigh the metal after drying it; the sooner this takes place the better, as the metal is easily affected by the moisture of the air. A precaution necessary to be observed in the management of the operation above described, is the avoiding of all such circumstances as tend to produce or accelerate a higher degree of oxidation of the dissolved iron in the solution. It is, therefore, indispensably necessary, as I have many times convinced myself, in order to insure success to the experiment—

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* The gramme is equal to 15,444 English grains.

1. That hot water, as free from air as possible, be used to soften said ore that has been treated with sulphuric acid.

2. That the solution of copper be highly diluted, and redden litmus paper. The precipitation of copper is hastened by adding a few drops of sulphuric acid to the liquid.

3. That the precipitation be made while it is warm.

4. That the iron be well polished and heated before using.

5. That the precipitated copper be quickly removed from the liquid above it, and in washing the same hot water be used. A copper assay of the above description requires two days for performance; one can, however, very conveniently, during this time, prepare twenty-four; when one has several of the same to make at once, it is advisable, in filtration, to make use of a shelf similar to that used with the re-agent glasses, on which each individual hole for the reception of the funnel is numbered. It is also desirable, to avoid confusion, to number the glasses in which the copper is precipitated. Should it be wished to determine the richness in copper, of copper-slate through these means, which are well suited for the purpose, it is necessary to heat the same red-hot, in order to drive off the bitumen. If it is supposed that the substance may not be perfectly decomposed by the sulphuric acid, for safety's sake we might put some drops of *aqua regia* to the dried up mass, before it is mixed with a second portion of sulphuric acid. This will happen, however, very seldom, for all those ores and smelting products I had the opportunity of trying, by this method, were always perfectly decomposed by the sulphuric acid, after they had been ground to powder, and a sufficient quantity of sulphuric acid applied; also, when the washed residuum was treating in solution with aqua regia, I never could detect the least signs of copper, examining and treating the solution with ferro cyanite of potassa, ammonia, and iron. If metallic sulphur, as, from the lead process (bleystein and bleispelse,) containing copper, are submitted to this assay, the component parts of lead and iron give in the state of sulphate, a white or yellow residuum, so that the solution will scarcely contain any thing else but sulphate of copper. Ibid.

FONTAINEMOREAU'S *new Alloys of Zinc—a substitute for Bronze, Copper, and Brass.*

An invention of a new alloy of zinc, with small proportions of other metals, found to possess very peculiar advantages, has lately been introduced into England, where it has been patented in the name of M. Lacomte de Fontainemoreau. It is likely to prove of great utility in the manufacture of machinery; and in castings relating to the fine arts, as a substitute for copper and bronze, will be extensively adopted. We suggested it as a material for casting the Nelson memorial, and we beg to reiterate the suggestion to the various committees now engaged in the formation of that, and other national testimonials.

The proportions of metals which have been found most advantageous in forming varieties of the alloy, after very numerous and extensive experiments, are as follows:—

No. 1.

Zinc,	90 parts.
Copper,	8 “
Cast Iron,	1 “
Lead,	1 “
	100 parts.

No. 2.

Zinc,	91 parts.
Copper,	8 “
Lead,	1 “
	100 parts.

No. 3.

Zinc,	92 parts.
Copper,	8 “
	100 parts.

No. 4.

Zinc,	99 parts.
Copper,	1 “
	100 parts.

No. 5.

Zinc,	97 parts.
Copper,	2½ “
Cast Iron,	½ “
	100 parts.

No. 6.

Zinc,	97 parts.
Copper,	3 “
	100 parts.

No. 7.

Zinc,	99½ parts.
Cast Iron,	½ “
	100 parts.

No. 8.

Zinc,	91½ parts.
Copper,	8 “
Cast Iron,	½ “
	100 parts.

The stated proportions of any of these metals may be slightly varied, so long as by such variation the alloy is not made too brittle or too soft; for instance, the proportion of copper may be varied from about one part to about twelve parts in every hundred, but any greater proportion of copper than this, and less than that used in forming common brass, would make the alloy brittle. The proportion of cast iron may be varied from about one-quarter of a part to about two parts in every hundred. The proportion of lead may be varied from about one to twenty-four parts in every hundred parts, but the presence of some third metal is necessary to produce a proper combination of the zinc and lead. Instead of pure copper or any other of the simple metals directed before to be used, brass or other alloys formed of these metals may be used; but where this is done, the quantity of copper and other simple metals contained in such alloys must be taken into account in calculating the relative proportions of simple metals which the new alloy is to contain in reference to the tables of component parts.

The principal object of the addition of the small quantities of copper, cast iron, and lead, to the larger proportions of zinc, is to change the manner of the crystallization of the zinc, after it has been fused and set to cool.

The new alloys are of a closer texture, more homogeneous and malleable than simple zinc, and some kinds of iron; are less liable to oxidation, and of a much finer grain than zinc, somewhat resembling that of steel, especially when the alloys are rolled; they are also easier filed than either zinc, copper, or brass, and the filings do not stick in and clog the file.

By casting the new alloys in metallic moulds, their hardness and homogenity is increased, and a sort of temper is imparted to them, resembling, or approaching to, the temper of steel.

For the purpose of rendering the alloys, which are of a silvery grey colour, perfectly suitable as substitutes for copper, bronze, brass, and other metals, the colours proper to the metals of which they are intended to be substitutes, is imparted to them by means of any solution of copper. The hydro-chlorate of copper is found to answer best.

Firstly, for giving the alloys a blackish bronze colour, they are treated with a solution of the salt of copper, diluted with a considerable quantity of water, and a small quantity of nitric acid may be added. Secondly, to impart a red or copper colour, add to the solution of salt of copper, liquid ammonia, and a little acetic acid; the salt of copper may be dissolved in the liquid ammonia. Thirdly, to impart a brass or antique bronze colour, either of the three following means may be adopted: first, a solution of copper with some acetic acid; second, the means above described for copper colour, with a larger proportion of liquid ammonia; third, water acidulated with nitric acid, by which beautiful blueish shades may be produced. It must be observed, however, that this last process can only be properly employed on the alloys which contain a portion of copper. In either of these methods of colouring, a solution of sal ammoniac may be substituted for the liquid ammonia. The quantities of each ingredient have not been stated, as these depend on the nature of the alloy, the shade or hue desired, and the durability required.

The blackish bronze colour may be superadded to the red or copper colour, whereby a beautiful light colour is produced on the prominent parts of the article bronzed, or on the parts from which the blackish bronze colour may have been rubbed off.

These new alloys may be used as substitutes for various metals now in general use, such as iron in various parts of machinery; iron, lead, tin, or copper, in pipes and tubes; and bronze, brass, and copper in machinery and manufactories, as well as for most of the other purposes for which more expensive metals are employed. Mech. Mag.

Geary's Patent Coal.

The formation of an artificial fuel has for some time past occupied no small portion of the attention of scientific minds. The high price of the natural mineral—the great space it requires for stowage—the quantity of its refuse, and the nuisance of its smoke, were amongst the disadvantages which it was sought to be overcome by some artificial combination of combustible matters. We have from time to time published accounts of the various patented methods of manufacturing artificial fuel and coal, and of various experimental usings thereof for steam-engines and other purposes, to which we have now to add, the particulars relating to another composition invented by Mr. Stephen Geary the architect.

Mr. Geary's artificial coal consists of a mixture of the following ingredients:—First, about half of small coal, or coal-dust; second, pitch, or bituminous matter obtained from coal, or other mineral or vegetable tar; third, coal or coke cinders, powdered peat, or bark of trees, sawdust or tan; fourth, powdered clay, freestone, chalk, plaster, earth, sand, or other earthy matters; and lastly, about a fortieth-part of some acid—sulphuric acid, as the cheapest, is that which is used by Mr. Geary.

The coal is manufactured in the following manner:—The pitch is to be melted in a pot, and the cinders gradually introduced—stirring constantly. The powdered clay is next to be added gradually, then one-half of the small coal; as soon as these matters are well amalgamated—being kept at a good heat during the operation—the acid is to be poured in, and well stirred through. An effervescence will in a short time take place, producing a froth on the surface of the mixture; and as soon as this appears, add the remainder of the small coal. The mixing of the ingredients having been completed, the fluid mass must be kept in a state of agitation by stirring until the whole is well and equally heated. The mixture may then be run into moulds of any desired shape. When the mixture has become partially cool, pressure or beating may be applied in order to compress the blocks of fuel into as small a compass as possible. The pressure or beating is not essential, except in cases where the coal is intended to be used as steam-boat fuel, where stowage room is valuable.

The ingredient in this composition, which is new, and from the action of which on the other component parts, the beneficial qualities of Mr. Geary's fuel result, is *the acid;* and he claims this addition of an acid or acids to the other matters which have all been used before, as constituting his patent. Some specimens of coal thus manufactured were submitted to Professor Brande for his examination and opinion, who reported as follows:—

"That it burns well, kindles readily, and has most of the characters of some of the bituminous coals. It undergoes combustion rather more rapidly than the ordinary Newcastle coal, but appears to give out as much heat, and to form a brisk, agreeable, and efficient fire, and I apprehend no objection to it on the score of smell, dust, smoke, soot or ashes, and it is entirely free from any quality prejudicial to health.

"I have no doubt that it might be available in the manufacture of gas and coke, but whether economically or not is a question which I have no means of determining.

"Accurately to ascertain the relative value of this fuel, as compared with the ordinary varieties of coal, would require a series of experiments upon a larger scale than I have been enabled to undertake, but from the trials which I have made of it, it appears to me to compete with the superior kinds of coal, and if so, the greater number of its applications to inferior purposes are matters of comparatively little moment."

Mr. Squire (chemist in ordinary to her Majesty) also reports very favourably of its merits in the following terms:—

"I have examined the properties of the Patent Coal, which you placed in my hands for that purpose, and have to report that it makes a cheerful fire in the open grate, the temperature of the room being more steadily increased, and the maximum of heat longer retained by it than with common coal, and although it does not throw out so violent a heat as the best screened coals, yet it has the advantage, if left alone, of continuing to burn till all is consumed to ashes, leaving no cinders; it is entirely free from any unpleasant smell, and when burnt in close vessels it yields nearly the same quantity of coke as the best coals do, and the gas given off burns with great brilliancy.',

These favourable opinions, we are happy to be able to say, have been confirmed by subsequent experience. The Commercial Steam Boat Company, in consequence of the beneficial result of some experiments they made, have adopted it for the use of their vessels. One experiment was in working the engines of the *Prince George* steam-boat from London-bridge to Chatham, Sheerness, and Southend. The same weight of Mr. Geary's coal was taken on board that was usually consumed in a trip to Chatham of common coal, and there was found to be sufficient to work the engines as far as Gravesend on the return voyage. Another trial was in the *Duchess of Kent* steamer. The quantity of common coal usually burnt by this vessel in a voyage to Ramsgate is *five tons*; she performed the voyage with *three tons and a half* of Mr. Geary's Patent Coal. The price paid for the common coal by the Commercial Company was twenty-three shillings per ton. The cost of the patent coal is eighteen shillings per ton. From this there appears an enormous saving in cost, in stowage room and in weight.

There are other advantages besides these which it is important to mention: the captains and engineers of the boats state that there are hardly any ashes left after combustion; no clinkers; only a light white vapoury smoke; and that the labour of stoking is much reduced.

We also understand that coke manufactured from the article has been used with great success on some of the railways, particularly the Eastern Counties.

An extensive manufactory has been erected for the production of this patent fuel, in the neighbourhood of Bow, and another is in preparation at Gravesend. Judging from the foregoing statements, we may venture to predict an extensive demand for this new article of commerce. [illegible]

Reproduction of Books and Engravings.

One of the most important discoveries is the one applicable to the reprinting of books, or reproduction of engravings. M. Dupont, a very industrious printer, was seeking the means of saving the expense of stereotyping. "With the assistance of a peculiar kind of ink, he was enabled to render the preservation of the stereotype plates unnecessary, and thus to save the large stock of materials, the space occupied by them, and the expenditure of much money; all which is effected by the mere preservation of a printed sheet which lithography would reproduce whenever it was wanted," but doubting whether the ink used upon that sheet would retain in the course of time the same properties, he consulted his brother, a very intelligent lithographer, and the latter found what neither ventured to expect. This new process is applicable not only to fresh printed sheets, but likewise to the oldest engravings, to the oldest books, and, what is of far more interest, to Greek, Chinese, and Hebrew books. It consists in two operations. Over the page or engravings of which you want a copy, you lay a particular composition. It is placed upon the lithographic stone and pressed, and the stone reproduces, with scrupulous precision, the original engraving or book. This impression could not, however, serve such as it is. It is itself covered with the same preparation, and it may then print thousands of copies, by the ordinary process of every sort of lithography. Five minutes suffice for both operations. The original engraving may be restored to the portfolio which has supplied it, for it has not been injured; the book, thus wholly reprinted may undergo another binding, and then honourably resume its place in your library. This new process admits of a reduction of seventy-five per cent upon the expense of printing; and as for engraving, that which on copper would cost one hundred francs, will now cost but twenty francs! What consequence will not this discovery yield? It threatens the graphic arts, engraving and printing, with a complete revolution. A man of the greatest talent in the art lays claim to priority in this discovery, as is always the case—when success has been obtained, claimants come in. The wisdom of the central jury and patent laws must decide the question. In the meantime MM. Duponts are manufacturing, which is always a great point. On Monday, the King, Queen, Madame Adelaide, and Princess Clementine again visited the exposition, and examined the lythotypographic produce of the brothers. His Majesty observing an engraved head of Albert Durer, of 1527, which was wanting in his collection of the Palais Royale, ordered a copy of it, and congratulated M.M. Duponts upon a discovery whereby there would be no longer any scarce engravings or books.

Paris Periodical for June.

Electricity.

M. Becquerel has read the first part of a memoir before the French Academy of Sciences, containing an account of his new experiments on the electric effects of contact. These lead him to conclusions concerning the causes of certain effects which differ from those of Davy, who ascribed them to mere contact. M. Becquerel refers them to friction, and hopes to prove it by the following experiments. First, two condensing plates, made of platina, were adapted to an excellent electroscope; one of them was touched with a heavy dry piece of chalk, and the other with the finger: on separating the plates, it was found, that no electric effect had been produced. Secondly, a layer of calcined lime, highly dried, was spread on a piece of wood, equally dry; upon this was carefully placed, so as not to allow of friction, a plate of copper, fixed to a handle: it was then put in contact with one of the plates of the condensator, while the other was touched with the finger. After repeating this several times, no electric discharge was obtained, but if the copper disc were placed on the lime with friction, the condensator was charged after touching a few times, and the greater the friction the stronger the charge. The lime assumed positive, and the metal negative electricity. Thirdly, if oxalic, succinic, benzoic, or boracic acid, was substituted for the lime, in the form of a very dry powder, electricity was also obtained by friction, but not by mere contact; and in this case, the metal took the positive, and the acid the negative electricity. Lastly, the same result was obtained from crystals of oxalic acid and lime. Therefore, says M. Becquerel, the results obtained by Davy are due to friction, and not to the electro-motive action of Volta.

Lond. Athenæum.

State and Prospects of the Iron Trade.

We learn from a very elaborate paper read by Mr. J. Johnson, before the Liverpool Polytechnic Society, that there are at this time in Scotland fifty furnaces in blast, five out, seven building, and twenty-six contemplated. In South Wales, 122 furnaces in blast, seven out, thirty-one building, and ninety-one contemplated. In 1740, the annual produce of the kingdom was 17,350 tons of cast iron. Mr. Johnson thinks it probable, from the above data, that in 1842, Scotland alone will produce upwards of 360,000 tons, and that within five years 1,000,000 tons will be produced annually in South Wales.

Ibid.

Progress of Physical Science.

"*Magnetical Investigations.*" *By the* Rev. Wm. Scoresby, B. D., *Fellow of the Royal Societies of London and Edinburgh; Corresponding Member of the Institute of France, &c. &c.*

We have, in this work, a series of magnetical observations and facts of exceedingly great interest, whether they be viewed in a theoretical point of view, or as of practical applicability. The labours of Mr. Scoresby, as an experimental philosopher, have long been sufficiently known to the scientific world to establish his reputation as an indefatigable and exact investigator; and we have great pleasure in stating that the originality of many facts which we have observed in this neat little volume, do equal credit to the author with any of the preceding results of his valuable investigations.

Mr. Scoresby prefaces his interesting Investigations with the following series of "Introductory Observations," so admirably appropriated to the scientific importance, and theological dignity, of his subject.

"It has long been conjectured that a most intimate connexion, if not an identity of nature, might probably exist among some of the more subtle and mysterious agents, or principles, of different denominations, and, apparently, of different characteristics, which universally pervade the region in and about this earth.

"Modern discoveries in electro-magnetism, with the cognate relations which these have developed as existing in other principles of natural bodies, have gone far to verify these anticipations; and at the same time to yield so much additional knowledge of the constitution of the physical system of our planet, as to give a new, an interesting, and a prominent, importance to electrical and magnetical science.

"To the time of Dr. Gilbert, of Colchester, magnetism was only known as a mysterious virtue, existing in, and peculiar to, the loadstone, or ferruginous substances which had been touched by this extraordinary mineral, from which certain qualities of attraction and direction were derived. But this eminent individual discovered, as he has left on record in his 'Physiologia Nova, seu Tractatus de Magnete et Corporibus Magnetisis;' published in the year 1600, that the phenomenon of the meridional adjustment of the magnetic needle was not owing to any mystical virtue, exercised out of the course of natural principles, but a mere result of the directive action of the earth; which he truly considered as the controlling agent, by reason of its being in its matter and constitution, magnetic.

. "So long as magnetism was known only as a separate or simple principle, the philosophic ideas of Dr. Gilbert were never materially advanced; but, on the discoveries of Professor Œrsted, whereby the long-suspected connexion betwixt electricity and magnetism was established, an amazing enlargement was at once yielded to magnetical knowledge, and a corresponding impulse given to magnetic research.

"The effect has been to give a science, formerly considered as comparatively of an inferior class, a grandeur of consideration; placing it at once amongst those mighty principles which infinite wisdom has appointed, and infinite power ordained, as essential elements or agencies in the physical constitution of the world. For inasmuch as the inseparable connexion has been established betwixt electricity and magnetism, these, under various forms of development, reciprocally developing each other, it necessarily follows, that, to whatever extent in creation electricity operates, to the same extent the magnetic principle must reach. And inasmuch as heat, light, and chemical action, are each, more or less, developers of one form or another of the electro-magnetic principle, the analogies of science would lead us to infer, that magnetism is co-extensive with these other agencies, throughout their range of operation. Hence, there is little doubt but the principle, which, a few years ago, was known only as a director of the compass needle, as to its utility, and as little more than a curiosity in science, is one of the mighty energies by which, instrumentally, the works of the great Creator are regulated; one of those subtle powers, which he hath ordained as his servants, 'fulfilling his word;' and whereby, 'the sweet influences' of the whole system of the universe are bound together, controlled and upheld. Thus the subject of magnetism becomes of the highest consideration; in science, as to its mightiness and extent of operation; and, in natural theology, as calculated to connect the researches of human intelligence, with Him who hath created these wonders; to elevate the feelings of reverence and adoration in the devotional mind, and to proclaim more clearly, in proportion as the invisible things are understood, 'His eternal power and Godhead.'

"It is not my object, however, in this publication, to carry out those views to which the more enlarged consideration of magnetism, as a science, might be advantageously applied; but that, in thus showing something of the importance of the subject as a science, I may solicit, for the contributions which are here offered for it, such reasonable consideration as, in this connexion, they may fairly claim.

"To the subject of *magnetism*, my attention has, for a series of years, been more or less directed; latterly with the view, particularly, of producing more powerful instruments for the determination of delicate variations in, and the actual condition of, the earth's magnetism; a subject which, from its greatly increased importance, is now engaging attention in some of the principal observatories in Europe.

"In contemplating such improvement in instruments dependent for their adjustment on the earth's magnetism, the grand desideratum would obviously be, the attainment of increased energy, or directive power, in magnetic needles, or bars of any given length or mass. And, that the attainment of such increased energy was a promising field of enquiry, I was satisfied, from the mere consideration of the surprising superiority in power of electro-magnets over permanent artificial magnets; strongly indicating the existence of a far greater capacity for magnetism, than we have hitherto been able to develop, or, if developed, to retain. Whilst this consideration yielded every encouragement to the enquiry, an experimental fact, in regard to the proportional power of magnets of *unequal thickness*, suggested that guidance, in pursuing the enquiry, which not only led (as will, I trust, subsequently appear) to a successful result in regard to the object particularly specified, but gave rise to investigations extending beyond my original design, and eminently calculated, I conceive, for the improvement of sea compasses—hitherto so very defective—as well as artificial magnets, and magnetic apparatus generally. The fact referred to was this. When examining, many years ago, the directive power of various artificial bar-magnets, for the purpose of determining the practicability of ascertaining the thickness of rocks, &c. in tunneling and mining, by the method of deviations communicated to the Royal Society in 1831,—the idea occurred to me, that, if the bars ordinarily employed for compass needles, &c., were divided into laminæ; or if, in other words, they were made up of thin plates to the extent of the masses of the bars commonly in use, a greater degree of energy would be obtained. Experiment fully justified this opinion. But previous to the application of the principle to instruments directed by the earth's magnetism, I had made trial of a combination of laminæ of *thoroughly tempered steel*, for the construction of a small compound magnet. The substance made use of was watch-spring, of which fourteen pieces, of two inches in length, were combined, after being magnetized, and formed a small magnet, weighing, in amount of steel, about one hundred grains. From a want of knowledge, at that time, of the best mode of magnetizing thin plates, the power obtained was much less than was expected; but when the same little instrument was subsequently magnetized, in a mass, by the process hereafter described, its efficiency became very striking,—the power being found to be such as to lift, by one pole, a polished nail of about 800 grains, or eight times its own weight.

"A trial apparatus, of the nature of a *variation needle*, on the same principle,—improved, however, for this purpose, by the *separation* of the plates—was constructed in the year 1836, which was exhibited to the 'British Association for the Promotion of Science,' the same year. But being without any *precise* knowledge of the laws of combination in magnetized plates, or even of the actual power of this instrument, though obviously great, a general idea only of its relative superiority could then be obtained. Since that time I have investigated, in an elaborate series of experiments, and with a somewhat expensive variety of apparatus, the principles of the construction adopted, so as satisfactorily to prove, I conceive, the decided advantage of that construction for sea, and other, compasses, and to apply the principle to various practical purposes in magnetics.

"In the original 'variation compass' just referred to, the plates, as I have intimated, were not placed in immediate contact, but separated by thin slips of wood or card-board; for I had previously found, when combining magnets for other purposes, that a material loss of power, in the individual intensities of the bars, was, in all cases, occasioned by combination: but that, when the combination was not made in contact, an inferior deterioration took place.

"The subjects to which I was primarily guided by these preliminary considerations and results, extended to the following particulars:—The effect of the division in various directions of the mass of steel, on its magnetic capabilities,—the law of combination of magnetized steel plates in contact—the law of combination when the plates are separated by limited spaces—the effect of temper or degree of hardness, and the degree of permanency of the power in combinations of magnetized steel plates. A few of the most important results obtained from these investigations, were forwarded to the Institute of France, in February, 1838. These investigations proved sufficient to show that the idea entertained in the outset of the practicability of producing, by means of combination of magnetized steel plates, more powerful apparatus than had hitherto been in use, for experiment and observation in magnetical science, and for practical purposes in magnetics generally, was not incorrectly founded. But the most important practical applications of these principles, with the results of several new and distinct investigations, yet remain behind. The description of these, in the first instance, is the object of the present publication: and it is hoped that the results will be found to develop some new and some improved principles of construction, applicable both to instruments designed to be directed by the earth's magnetism, and to the improvement of apparatus in which a permanent and concentrate energy are requisite; together with a useful application of some of the laws developed in these or previous investigations, to the *testing* of the quality of steel, and the determining of the degree of its hardness, purposes of the highest importance in the construction of delicate instruments used in the arts, or by professional men.

"The several results and applications of these recent personal researches, may be conveniently classed under separate heads, belonging to the development of principles, or of different practical processes, in magnetism. Some of these will, no doubt, be resolvable, in certain particulars, into principles or methods heretofore known; but, in all, it is presumed, something peculiar, as to decisiveness of the results bearing on principles, or as to convenience of adaptation, or efficacy of manipulation, or improvement in construction, in regard to the practical subjects, will be found."

From the above prefatory chapter, our readers will discover that the objects of Mr. Scoresby's investigations are of a high scientific character; and we can assure them that we have not met with so valuable a work on magnetics as that before us, since the appearance of the second edition of Mr. Barlow's "Magnetic Attractions," a work of great merit, and intrinsic importance, in this branch of physics. It is such productions as these that every scientific man delights to peruse; and every scientific journalist ought to take a pleasure in recommending to his readers. Every novel fact that becomes developed by physical enquiries gives new impulses to the pursuit, implants an additional gem in the diadem of science, enhances the lustre of the whole, and, sooner or later, yields new sources of comfort and happiness to man.

Annals Electricity.

On the Nature of Electrical Attraction.

Mr. Snow Harris lectured, May 31, at the Royal Institution, "On the nature of electrical attractions." This gentleman, as is well known, is distinguished for his experimental researches, and for his elegant skill in devising the beautiful apparatus, by means of which he has conducted them. It is principally adapted to the purpose of ascertaining in the most precise and unvarying manner, the exact quantitative measures of the electrical charge given to bodies, and the relations of the forces under varying circumstances, as expressed in weights. The first object is obtained, by having a unit measure in the form of a very small Leyden jar, the electricity of which, when fully charged, passes by a spark to a very large jar in connection with the body to be electrified, the number of sparks determining the quantity. By this arrangement, the intensity of the charge is moderate, even when a considerable number of sparks have passed. The second object is obtained by means of a very delicate balance, having in place of one of the scale pans a piece of gilded wood, to constitute the attracted body, (which can be replaced by others of various shapes and sizes, according to the nature and purpose of the experimental inquiry,) beneath which, adjustable to any distance, is the body to be electrified, composed also of gilded wood of various shapes and sizes. The weights in the scale pan, determine the degree of attractive force, under the several circumstances of distance, size, shape, insulation, &c. There were modifications of this instrument, suited for special purposes, and also one on a different plan, but having the same object in view, in which an index, mounted on friction wheels, traverses a graduated arc, and has a pulley on its axis, round which is a silk thread, one end being attached to the body electrified by induction from the directly electrified body beneath, and the other end being connected to a counterpoise dipping into a glass of water. Thus the attractive force is estimated in this case by degrees instead of by weights, through the alteration of the buoyant force of the fluid exerted upon the counterpoise, as it is more or less immersed.

By means of this and other apparatus, which it would exceed our limits to describe, the lecturer performed many interesting experiments, some of a popular kind in order to illustrate a few elementary points; but the chief scientific object, was to show, in opposition to mere mathematical theories, that the law of electrical forces, varies according to circumstances; that it is as the inverse square of the distance, only, in the case of uninsulation, but when the attracted body is insulated, that it is simply as the inverse of the distance. This was shown, both by the different number of sparks required, and by the different weights required in the different cases, to produce an equilibrium between the forces of gravity and electricity. Hence the mathematical postulate that electrical forces, like that of gravity, radiate from a centre, is an unfounded assumption, resting on an analogy which the physical character of the phenomena does not countenance; for if such were the case, those forces would, by a kind of inherent necessity, follow the ratio of the surfaces related to that centre, and consequently act with an intensity proportioned to the inverse square of the distance. But the law as experimentally developed, being in a certain case simply as the inverse of the distance, the inference is, that electrical influence acts in parallel lines. This view is borne out by experiment, for if to the surface of the electrified body, is opposed a smaller surface in the attracted body, (of course both bodies are mutually attracted, but we use the term as distinctive of the one which is put in motion) the force of attraction will augment with every increase in the smaller surface until it attains its maximum, which will be, when the two surfaces become equal, beyond which it will not be added to or diminished, by any enlargement whatever of the non-electrified surface. This conclusion from the experiment is perceived with greater force, when it is considered that the attracted body is attached solely in virtue of an opposite state of electricity residing over the whole of its under surface, induced in it by the directly electrified body. The inference is further confirmed by other experiments, touching the relation between spherical and plane surfaces; thus, to select one instance, the attractive force of two opposite spheres, is precisely the same as the influence of the two nearest hemispheres.

It is the peculiar reflex action of the induced electricity in the attracted and insulated body, which, augmenting the totality of the force, produced also, as we understood the lecturer, that modification of the law as before stated, which obtains in this particular case. It was also shown, that the augmentation of the electrical force by induction, is in the ratio of the square of the quantity, or, the quantity being the same, that the force is doubled. The illustration of the latter fact by experiment, was exhibited by means of the second instrument before described. In connection with the electrified body, was a large circular disk, the communication with the machine being through the latter, underneath which, was a second insulated disk of the same size; this being withdrawn, the index showed a diminution of attractive force by one half. Mr. Harris also gave a few experiments which led him to believe in the materiality of electrical influence, and that it does not consist in molecular vibratory motion—one of which was, the uninterrupted energy of its propagation, which is exhibited in a conductor bent to a right angle. He also adverted to the fact, so contrary to received opinion, that he had been able to retain a charge on an electrified body in a vacuum for a considerable length of time.

Remarks.—We are sorry that we have been able to give only the above rather imperfect notice of this interesting lecture, so far at least as regards the precise details of the experiments, owing in a great measure to the lecturer having turned his back upon a part of the audience whilst performing them, (the instruments having been placed on the front of the table) so that situated as we were, neither seeing nor hearing fell to our lot. A reiteration of statements by the lecturer is also very desirable in certain cases. We hope, however, that we have not materially misunderstood him on any point, though we confess we do not perceive, how the *law* of electrical force is affected by any variation in the reflex action of induced electricity, the tendency of which would seem to operate only on its intensity. So great a change in the law, points to its being of a secondary kind, resulting from different mechanical actions, dependent on essential differences in the physical circumstances of each case. The researches of Mr. Harris well deserve the attention of mathematical theorists, the discrepancies which he has brought to light, are not to be slighted and passed over as being merely apparent anomalies arising from the complication of the mutual actions, and which theory could elucidate, even to the bringing out of the same results, if pursued into, and made to embrace, all the minutiæ of the case. Mr. Harris does not belong to this self-sufficient *a priori* school, the old Aristotelian spirit of which is ill concealed by its mathematical guise, but he is a philosopher of the right stamp—cast in the true Baconian mould—one who being distrustful of the power of mere intellect to deal with the secrets of nature, is inclined to pay a greater deference to her teachings than to those of man; and who would sooner suspect the conclusions of theory, than even the slighter inferences from experimental investigations, and much less, those more legitimate inductions, which depend on, and are guaranteed by, varied attesting confirmations. Lond. Mech. Mag.

On the Polarization of Light by Living Animals. J. F. GODDARD, *Lecturer on Optics, &c., at the Royal Gallery of Practical Science.*

On repeating the experiments published in 1816, and others subsequently noticed by Sir D. Brewster, on the polarizing property in the eyes of fishes and other animal substances, with my Polariscope, after observing that the *scarf skin* of the *human subject*, sections of *human teeth*, the *finger nails*, *bones of fishes*, &c., possessed the same property, I was led to examine some living objects, when I discovered that, among many others, the larvæ and pupa of a tipulidan gnat (the *Corethra plumicornis*) possessed this property also, and that in a very eminent degree. Its existence in the different substances above enumerated is exceedingly interesting and important; but that it should also exist in living animals is infinitely more so, and opens a new field altogether, disclosing characters that lead to an intimate knowledge of their anatomy, and which cannot possibly be discovered by any other means.

This creature is found in large clear ponds, generally in great abundance when met with, but this is by no means common. Having constructed a water trough, made with two slips of glass about 1.25 inch wide and two inches long, with very narrow slips of thin glass cemented with Canada balsam between them, at the bottom and sides, thus leaving it open at one end, with about the 0.050 of an inch space between in the middle, I filled it with clear water in which I placed some of the larvæ; and such is the extraordinary transparency of the creature, as to display in a most beautiful manner the whole of their internal structure and organization, and which, when viewed in polarized light, presents the most splendid appearances. Thus when they place themselves with their head and tail both in the plane of primitive polarization, or in a plane at right angles to it, they have no action upon the light transmitted through them; but when in a plane inclined 45° to the plane of polarization, the light is depolarized, their whole bodies becoming illuminated in the most brilliant manner, varying in intensity according to their size, and the nature of the different parts and substances; the peculiar interlacing of the muscles marking out regular divisions, which, as the creature changes its position with regard to the plane of polarization, exhibit all the varied hues and brilliant tints that have rendered this important branch of physical optics so exceedingly interesting.

And while thus viewing them, if we place behind, a thin plate of sulphate of lime or mica, the change and play of colours as the creature moves are greatly increased, and exceedingly beautiful.

These phænomena in the larvæ of the *Corethra plumicornis* are seen if possible in a more splendid manner in the spawn of many large fishes, but more particularly in the young fishes themselves, which in their early state are, many of them, equally transparent, particularly those of marine production.

The first time I showed them was on the 7th June to Mr. F. Watkins, afterwards to T. E. Wilks, Esq., and other gentlemen; and on Tuesday evening the 25th June, I read some notes on the subject, and exhibited them with many other experiments, to the members of the Zoological Society, at one of their regular meetings. Philos. Mag.

Remains of the Mammoth dredged up in the English Channel and German Ocean.

The fishermen employed off the east coast of England are frequently impeded in their operations by large boulders and bones of mammalia becoming entangled in their tackle, and in order to clear their fishing grounds of such obstructions, they bring the masses on shore. The animal remains noticed in this paper are chiefly in the possession of the author, and consist of tusks, teeth, and bones of the mastadon. They were obtained between Dungeness and Boulogne, Dover and Calais, and Yarmouth and the coast of Holland; and Capt. Martin states, that they were wholly procured in hollows or submarine valleys. The boulders are also accumulated in depressions, and consist of a great variety of rocks. Some of them are much worn or rounded, but in no instance do they present those regularly-shaped forms which would lead to the inference that they might have composed part of shipwrecked cargoes.

To this communication was appended a note by Sir John Trevelyan, on a molar of an elephant found thirty-eight years ago in the bed of the Severn, near Watchett. The same gentleman has also informed Dr. Buckland that Roman pottery has been frequently procured during the last fifty years from the bottom of the estuary of the Thames, near Margate; and that Pott Island, off Herne Bay, has received its name from the quantity of similar remains obtained near it. A Roman vessel, laden with pottery, is supposed to have been wrecked at this spot. Mining Review.

Five Fossil Trees found in the excavations for the Manchester and Bolton Railway.

One of these trees was discovered in 1837, and the other four during the present year, in forming a drain. They are situated in a nearly straight line, in beds of shale belonging to the great Lancashire coal field; and the distance between the first and the fifth is about 105 feet. The roots, as far as they have been exposed, are spreading, and they are apparently quite conformable in position to the inclination of the stratum in which they are imbedded. The stems are nearly at right angles to the plane of stratification, and were enveloped, when discovered, in a thin coating of friable coal. The internal argillaceous casts are fluted, and Mr. Hawkshaw states that there are indications of a fibrous structure. The largest tree is eleven feet high, fifteen feet in circumference at the base, and seven and a half at the top. The others vary in height from six to two and a half feet, and in circumference at the thickest part from nine to six feet; but the girt is not always proportioned to the height. The roots of one of the largest specimens extended between five and six feet from the trunk. A thin stratum of coal was cut through on the same plane as that of the roots, and on excavating on the opposite side of the rail road, the seam was also found at the distance of about ten yards. In the immediate neighbourhood of the roots the shale contained so great a number of *Lepidostrobus variabilis* that more than a bushel of specimens was collected.

Of the generic characters of the trees, Mr. Hawkshaw offers no opinion, as the coal which occupied the place of the bark was too friable to permit the external markings to be determined; he, however, alludes to the opinion of M. Adolphe Brongniart, that the *Lepidostrobus variabilis* was the organ of fructification of a species of Lepidodendron.

Mr. Hawkshaw has not only prevented the trees being removed from the position in which they were discovered, but he has had them protected from the weather; and he invites geologists to examine the interesting phenomena which they present. Ibid.

Coal-fields of Nova Scotia and Cape Breton.

The mineral products of Nova Scotia are extensive and valuable, forming already a large proportion of its exports, and promising to rise rapidly in importance. Coal, the most useful of any, particularly abounds, and has its value greatly enhanced by the great demand for it over the whole of the American continent. The chief bed, on the northern coast near Pictou, is estimated to comprehend an area of about 100 square miles; but this space is intersected by large dykes and interrupted by faults, so that the actual extent is not yet ascertained. There is some reason to think that it may stretch considerably farther, though sunk too deep to have yet been traced. It has a glossy, jet black appearance, is highly charged with bitumen, melts and cakes like that of Newcastle, and, when the tar is dissipated, burns like coke. It is extremely well adapted for manufactures, especially in iron. Farther east, near Pomket and Dorchester, copious indications of this mineral have been discovered, but not yet examined. In

Cumberland also, pretty large veins have been traced, though the quality is not uniformly good. Cape Breton is equally distinguished for its stores of this precious mineral. The Sydney coal-field, extending along the coast from the capital to Miray Bay, and thence inland to the great entrance of the Bras d'Or, is estimated to contain 120 square miles of workable coal. It is generally of excellent quality, and in great part adapted for domestic use as well as for manufactures. In the western district of this island, too, there appears to be a considerable bed, though not yet scientifically explored.—*Edinburgh Cabinet Library, No. XXVI. Historical and Descriptive Account of British America, vol. II.*

Progress of Civil Engineering.

The Great Western, Cheltenham and Great Western, and Bristol and Exeter Railways.

"The Great Western Railway has always occupied a great share of public attention, equally from its position, as from the peculiar features which distinguish its construction. It forms a direct communication through Bath between London and Bristol, and is one of the most important lines of traffic in the kingdom. Passing through the middle of the south of England, it commands the traffic of above two millions of people and of the richest part of the island with the rest of the country. The vale of the Severn, with a large population, is also one of its general tributaries; and altogether it occupies a position perhaps unequalled in railway communication. Branches are already in progress, giving it, by Cheltenham and Gloucester, a second communication to the north, and by the Exeter line a certain monopoly of the south-west of England. Of the road to the south of Ireland it can never be deprived; and recently it has entered successfully into competition for a portion of the American traffic.

"It is 117½ miles long, and proceeds through the basin of the Thames as far as Swindon, soon after which it enters that of the Avon, which it pursues for the remainder of its course. It commences in some of the earliest formations of the tertiary period of the London basin, in which it continues nearly as far as Reading: it then passes through the chalk for some distance, and ends in the secondary formations, which are compressed as it were together a short distance from its terminus. It affords as great a variety of geological sections as can be obtained on any line, and is one of the best tours that can be pursued by the geological amateur. Following the banks of the Thames, it visits scenes richer in their historical and literary associations than any part of the empire; and affords never-failing enjoyment to the admirer of the placid beauties of English landscape. On the right it has the renowned spa of Cheltenham and the unrivalled scenery of the Wye; and after passing through Bath it has on the left countries as rich as they are picturesque. Thus it vies with any railway in the world for the beauty of its position; and it is of itself an interesting feature, from the grandeur and novelty of its construction.

"After the usual surveys, and the accustomed time spent in obtaining capital, this great undertaking received the royal assent to its Act of Incorporation on the 31st of August, 1835, and active operations were immediately commenced to ensure its energetic prosecution. It is one of the most simple lines in its section of any railway in the kingdom, and is formed of two principal inclined planes. It was the object of Mr. I. K. Brunel, its projector and engineer, to make the plan as perfect in its details as the present state of science would permit, and, so far as practicable, to anticipate the future progress of railway improvement. One of his endeavours was to obtain a line as nearly level as the nature of the ground would permit; and he has so far succeeded, that, according to the testimony of the most eminent engineers, it is unequalled for its gradients. There is only one summit level, which is at Swindon, near the Cheltenham branch; and here it is 253 feet above the London depot, and 275 feet above that at Bristol—76 miles distant from the London end, and 41½ from the other terminus. From London to Dudcot it rises gradually at a rate not exceeding four feet per mile, or one in 1320, and generally under that. Thence to Swindon it continues to rise with a maximum inclination of 6 feet per mile, or 1 in 880. From Swindon to Bath the general gradient is 6 feet per mile, or 1 in 880; but it is broken by two inclined planes, both of 1 in 106 or 50 feet per mile—that at Wootton Basset 1 mile 3 furlongs in length, and that at Box of 2½ miles. The curves are chiefly of 4, 5, or 6 miles radius, and are as gentle as possible; one curve, however, is not more than three-quarters of a mile radius.

"For 96 miles from London there is no tunnel, until we come to that at Box, which is the longest on the line, being 1¾ miles in length; but between Bath and Bristol are four, one of 528 yards (1-3d mile,) one of 1012 yards (½ mile,) one of 132 yards, and another of 435 yards (¼ mile.) The tunnels, although for a longer line, are three-quarters of a mile less than on the London and Birmingham Railway. The width of the tunnels is 30 feet, and their height varies from 25 to 30.

"The cuttings are about ten millions of cubic yards, and, according to the Parliamentary evidence, are lighter than on any other principal line; the proportion being, for the Southampton, about 200,000 yards per mile; for the London and Birmingham, 110,000; for the Liverpool and Manchester, 100,000; and for the Great Western, 80,000. The average of the deep cutting is from thirty to forty feet, and of the embankments from twenty-five to thirty feet, and they rarely exceed these heights.

"The construction of the Great Western Railway differs from that previously adopted, and these variations may be arranged under several heads. The width of gauge or distance between the rails generally used is four feet eight inches and a half, but experience has shown, on the Liverpool and Manchester Railway, that the rails are too narrow for the boiler-room they want. On the Czarsko Selo Railway six feet has been allowed, and in Ireland a wide gauge has been preferred. The width determined upon by Mr. Brunel is seven feet, and the reasons in favour of it are, that it will allow of a higher rate of speed. The diameter of the wheels of the carriage has also been increased, while the centre of gravity of the carriage is kept low; and thus less friction and greater steadiness of motion are obtained. All sorts of carriages can be carried within the wheels of the trucks, and larger and more powerful engines may be employed. Mr. Brunel has also in some places substituted for blocks a continuous bearing of timber, with piles, upon which the iron rails that constitute the track of the wheels are placed. Longitudinal timbers of Memel pine, Kyanised, of a scantling of from five to seven inches in depth, and twelve to fourteen inches in breadth, and about thirty feet long, are placed along the whole line. Then these timbers are bolted to cross sleepers or transoms at intervals of every fifteen feet; double transoms, each six inches broad, and nine inches deep, being placed at the joinings of each of the longitudinal timbers, and single transoms of the same scantling being placed midway between the joinings. These transoms stretch across, and are bolted to all the four lines of rails. Within the two lines of rails of each track, piles of beach, Kyanised, are driven from the upper surface of the railway into the solid ground, so as to retain a firm hold thereof, and the transoms are bolted to the heads of these piles. These piles are so arranged that the piles of the corresponding rail are placed opposite to the intermediate distances, and not opposite to each other. To prevent the sleepers from spreading, there are, at every fifteen feet, iron ties across the railway, spiked down at each end to the sleepers.

"The Bristol and Exeter Railway branches off from the Great Western, near Bristol, and runs parallel to the estuary of the Severn, as far as Bridgewater, when it follows the course of the rivers Parret and Tone, and of the Bridgewater Canal as far as Taunton. It then runs by the side of the Western Canal, and afterwards enters the valley of the Culm, which it pursues until its junction with the Exe at Exeter. It is on the same grand scale as the Great Western, and under the direction of the engineer Brunel, who has distinguished himself so much by his exertions to secure their good construction. The length of this railway is seventy-six miles; and although the country through which it passes is difficult, yet it presents comparatively but little cutting, embankment, or expensive work. The capital of the company is 1,500,000*l.*, and the amount to be raised by loans 500,000*l.*" Min Rev.

Influence of Railways.

The history of the great railway between London and Birmingham is now finished. A wonderful work it is to look upon, whether it be contemplated in its magnitude and difficulties, its science and capital, or its utility and results. It stands as much the monument of this age as any of the great works of antiquity that have been the subjects of the world's history. There is, however, this difference in its favour, that while they have been raised in the cruel exercise of despotic power, and have mainly subserved the purpose of personal vanity, this has been accomplished by the profitable employment of the redundant capital of a single district, to meet the wants of a vastly improved people, and is the triumphant invention of science, trained and disciplined under severe study, and gathering accelerated strength from the successful experiments of each succeeding year. The flexible power of steam was, indeed, known to the philosophers of former times; but they used this knowledge only for the fantastic purposes of caprice and amusement. Anthemius, in the age of Justinian, employed his acquaintance with this principle to annoy a troublesome neighbour, and by imitating an earthquake frightened Zeno out of his house; and, at an after period, Pope Silvester invented an organ, which was set in motion and worked by it. It is the glory of the present era, that science and utility go hand in hand to advance the improvement and happiness of the nation.

Every age of the world has furnished its own peculiar inventions, and these have generally been well adapted to the wants that suggested them, and to the condition in which society was at that time placed. It is a subject more than commonly interesting to contemplate genius toiling amidst so many difficulties, and by patient perseverance overcoming all perplexity and opposition. It is, perhaps, still more interesting to observe it under the trials of its first experiments, amidst the doubts, unbelief, and sometimes jeers, of the multitude, self-possessed in the truth of its principle, yet tremulously fearful while lying at the mercy of the thousand contingencies that might thwart or destroy its hopes and expectations. Such was the case with Telford, on the final erection of the famous hanging bridge over the Menia Straits. It is said that his heart sunk as every successive bolt was struck, till overcome with the agony of his feelings, he retired to his cottage hard by, and awaited on his knees the result. The shouts of the admiring populace, when the wonderful fabric settled into its place across the turbulent waters, and his own almost inarticulate thanksgiving in his secret chamber, arose together in the triumph of that hour.

When poor Henry Bell, after years of thought, labour, and experiment, first pushed his steam vessel on the Clyde, it was done amidst the scoffs and evil surmises of those who assembled to witness the scene. The inventor died in poverty; but an obelisk that rears itself on the banks of that fine river, near Dunglass, attests the tardy, and to him almost useless, gratitude of his countymen. Fulton embarked on the Hudson with the same contemptuous greetings and prognostications, from the very people who assembled in thousands to hail the arrival of the Great Western and Sirius steamers, across the vast Atlantic, to their own shores. He lived to see, and in some degree to share, the complete success of his genius and mechanical skill.* How deeply we are indebted to these children of science who carried forward their discoveries,—in the benefits of which we so largely participate,—almost broken-hearted, amidst the chilling indifference or the withering contempt of a selfish world!

The work of which we have been treating has involved nearly, if not altogether, a capital of six millions of money in its completion. This enormous amount will require three hundred thousand pound per annum, merely to pay its interest, at five per cent., besides a very considerable sum in addition, to defray the wear and tear, and other expenses of its yearly operations; and yet with all this immense outlay, it is certain, from the host of travelers it will allure into a state of locomotion from pleasure or profit, and the various lines that will eventually flow into it, that it will be one of the most productive railways in the kingdom. We cannot, indeed, clearly foresee the end of such an invention, of which this is one of the greatest experiments, or the condition of society it may ultimately produce; but we are warranted in believing that this onward state of improvement, by facilitating and enlarging the sphere of social communication, will tend greatly to increase the amount of social happiness; and in its combining and assimilating influences over the great human family, will assist in bringing about the benevolent purposes of Him, "who hath made of one blood all nations of men for to dwell on all the face of the earth." C.E. & Arch. Jour.

Cornish High-pressure, Expansive, Condensing Steam Engine at Carlisle.

On Saturday last, the 25th ult., the engine manufactured in Cornwall by Messrs. Harvey & Co., of Hayle, from the specifications and plans of that eminent Cornish engineer, William West, for the Carlisle Canal Company. commenced working. The directors having assembled at twelve, in a few minutes after, the engine was started by Mr. Halson, the chairman, and Mr. West, who had arrived from Cornwall for that purpose. The volume of water sent forth excited universal surprise amongst the numerous gentlemen and artizans whom curiosity had drawn to the spot, and was gratifying in the highest degree to the directors and proprietors of the company.

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* The engine used by Fulton, in his first steam boat on the Hudson river, was made by Messrs. Boulton & Watt, of Soho.

The engine (named the "Eden") is set up for the purpose of supplying the Carlisle Canal with water from the river Eden. The height the water has to be lifted is about fifty-six feet; the steam cylinder is sixty inches diameter; that of the pump forty-five (the largest of the kind in the kingdom;) length of stroke ten feet. In less than two minutes, the huzzas of those assembled announced that water had been lifted to the pump-head, whence it was poured fourth in a solid, continuous, and rapid steam, at the rate of 6624 gallons per minute; consequently, working at twelve strokes, the quantity delivered in twelve hours into the canal is 4,769,280 imperial gallons of water—equal to 765,288 cubic feet—at an expense of fuel under 5*s*.

The canal from Carlisle to the Solway Frith is about twelve miles in length. There are six locks, each about sixty-seven feet long, twenty-two feet wide, and eight feet six inches deep; and when required, such is the power of this simple, yet effective machine, that the quantity of water contained in each lock can be replaced in less than ten minutes—*i. e.*, as quick nearly as a vessel can be passed through. In the course of a month, when Harvey and West's new patent valves shall be subsituted for those now in use, the work will be done better, and with considerably less friction; and the heavy blow, and consequent vibration common to all pumping-engines will (it is said) be entirely overcome.

Mr. West's engine, at the Fowey Consols Mine, in Cornwall, on a trial, lifted 125,000,000 lbs. weight, one foot high, with 94 lbs. of coal, and averaged upwards of 90,000,000 during twelve consecutive months. At the Portsmouth and Farlington Water Works, the consumption of coal has been reduced (and doing more work) full 75 per cent., and a further saving will yet be effected, by the introduction of the patent valves. At the office of this company, 15, St. Mary Axe, London, full particulars will be given to any gentlemen of the north interested in coal mines or steam power. Mr. Wicksteed, the highly talented engineer of the East London Water Works, computes their saving at 70 per cent., viz., 1297*l*. 16*s*., instead of 4328*l*. 2*s*. The engine at the East London Water Works has a cylinder of eighty inches, is now at work night and day, and has turned idle three engines of large dimensions erected by Bolton and Watt; further saving will likewise be effected there as soon as the new patent valves are in operation. These valves cannot fail to rank amongst the most useful and important introductions of the present day, and for deep mines or exceedingly heavy columns must come into general use. Neither of the engines before noticed, nor any engine we have ever heard of in the north, is equal in size to that lately sent to some extensive coal works near Namur, in Belgium; the cylinder of which is ninety inches diameter, stroke eleven feet, manufactured likewise by Harvey & Co., of Hayle Foundery; but as to "duty," the Cornish engines are so pre-eminent, that comparison must not be instituted. Some of the engines in the north, lately erected, are amongst the worst to be seen at the present day in Europe.

Min. Jour.

The Bude Light in the House of Commons.

The experiments of the Bude lights for lighting the House of Commons were lately tried, chiefly with the view of ascertaining the effect of the new plan upon the reporters' gallery. As far as that part of the house was concerned, we can say the trial was altogether successful. Though the apparatus for conveying the light to that, as well as to other parts of the house is not yet complete, yet enough of its operation was seen to show, that when complete, its superiority over the wax lights will be past all question. We understand that on the first trial, the complaint was general that the glare thrown into the body of the house was greatly offensive to the eye, while the seats under the gallery were in comparative obscurity; the grounds of this objection have now been wholly removed. The light is now made to descend from the roof through ground glass plates, over which the apparatus is so contrived that the light can with ease be varied from the colour of a pale moonlight to a bright sunlight, or be mellowed down to a rich autumnal glow; still giving sufficient light, without any unpleasant glare, to every part of the house. The glass through which the light is sent down is fitted air-tight into the bottom of the chandelier, so that no heat can be generated by it in the house, save the slight radiation from the surface of the chandelier itself; but compared with the heat and the consumption of atmospheric air, by the combustion (or rather the very imperfect combustion) of 240 wax candles, the heat and atmospheric combustion of the new plan are not (as far as the body of the house is concerned) as 1 to 100. Whatever heat may be generated by the new process will be carried off through the roof, and never affect the body of the house. To those of our readers who may not be acquainted with the nature of what is called the "Bude" light, it will suffice to say, that in Mr. Gurney's plan it consists in a number of burners (in each chandelier) supplied with wick and oil, somewhat like the Argand lamp, with the improvement that in this there is only one circle or cylinder, while in the common Argand lamp there are two. Lighted in this state, the lamp would send off a very large and offensive mass of unconsumed carbon; but to prevent this, a stream of oxygen gas is made to pass through the centre of each burner, by which the total combustion of the carbon of the oil and wick takes place, and the light is consequently raised to a beautifully brilliant flame, the intensity of which may be increased according to the volume of the stream of oxygen passed through it, and, as we have already said, the light may be mellowed as taste, fancy, or convenience may suggest. From what we saw last night we think the very clever plan of Mr. Gurney a vast improvement on the present system, and, as Joe Hume would say, "it is a great deal cheaper."*—*Times.* Mech. Mag.

Opening of the Eastern Counties' Railway.

A large concourse of persons assembled on June 18th at the temporary station, Devonshire-street, Mile-end, to witness the departure of the first train on this line of railroad. Shortly after one o'clock the train started amidst the firing of guns and general acclamations of all present. The line commences at Shoreditch, on a viaduct about twenty-one feet above the level of the ground, up to which extensive and commodious carriage approaches will be made. At the commencement of the viaduct it is proposed to erect the London station, which will be of commensurate extent with the existing traffic. In it are several bridges, the arches of which are faced with stone, which gives them a handsome and imposing character, especially the bridge over Devonshire-street, the arch of which rises less, for the span, than we have observed on any other line of railway, the rise being less than one-tenth of the span. The line then passes over the Regent's Canal by an iron bridge, the general appearance of which has been much admired; two main ribs of iron, of fifty-four feet span, partly on the bow suspension principle, are thrown over the canal, to which transverse girders are fixed, supporting the roadway, on which are laid longitudinal sleepers of timber receiving the rail. An ornamental railing gives a finish to the whole. Passing successively over the River Lea, Grove Road, Coborn Road, Fairfield Place, and Old Fort Lane bridges, besides numerous other smaller archways, the railway passes over the Stratford marshes, within a few feet of one of the extensive reservoirs of the East London Waterworks. On this part of the line there are numerous bridges over the various streams and rivers which the railway intersects, some of which are of considerable magnitude, such as the Stratford viaduct of five arches, each of thirty-six feet span, the Mill-pond bridge of forty-six feet span, Kent's Mill bridge of four arches, and the Abbey River bridge, all of which are over tidal currents, besides numerous other small archways. The Stratford station is erected after the style of a plain Italian villa, fitted up with waiting-rooms, carriage-shedding, engine-house, and repairing workshops for the engines. The depth of the cutting which immediately follows this station varies from ten to twenty feet. The public terminates at Barrack Lane, immediately adjacent to the town of Romford; the total distance is about ten miles and a half, which the trains will accomplish in less than half an hour. The engineer to the line is Mr. Braithwaite, to whom much praise is due for the generally efficient manner in which the works have been executed, and the engineering difficulties (not a few) surmounted.—*Ibid.* Ibid.

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* We should be glad to see some account of the manner in which the oxygen gas is supplied,—the material used in its production, size of the gasometer, &c. G.

The Oxford Street Experimental Paving.

On Saturday, the 18th ultimo, in accordance with the arrangements made by the Marylebone Vestry, limiting the period of the trial of the respective experimental pavements laid down in Oxford street until the month of May, Mr. Kensett, as chairman of the Paving Committee, laid before the board the state in which each of the experiments was. The following is the result:—On examining the bitumen laid down by the Bastenne and Gaujac Bitumen Company, they found it had stood the test of the severe wear and tear of the vehicles passing that road during the whole winter, without any material alteration. That portion laid down by the Val de Travers Company, which had been studded with stone, had stood, but that portion in which the broken granite had been set in their liquid had totally failed, and must be removed immediately. The Aberdeen granite cubes laid down by the parish had proved to be in most excellent condition; that more particularly which had been set in Claridge's Asphalte was in a state of superior order, and the stones appeared immovable. Robinson's bitumen had been taken up some months since in consequence of having proved a decided failure. The Scotch asphaltum had been repaired once, and had again become so dilapidated as to render the portion of the road which it occupies dangerous. The wooden block pavement, which had been laid down five months since by the projector, Mr. Stead, had excited the minute attention and admiration of the committee. It appeared, on examination, that the blocks formed a road of a most even surface, and carriages passed over without the slightest noise, and of the twelve inches, the length of the blocks, it was found they had not been diminished one quarter of an inch. Their attention, however, was particularly directed to the bottom of the blocks, which, to the extent of about three-fourths of an inch, appeared discoloured by a blue stain, intimating that the first approach of decay was making its appearance. A considerable division of opinion existed among the committee upon the above appearance being that of decay; they were, however, of an unanimous opinion that a further trial was necessary, in order to enable the vestry to be fairly satisfied as to the durability of the pavement which might ultimately be decided upon, and that any decision ought to be deferred till the autumn. It was ultimately decided in the vestry that the application of a Mr. Geary to lay down a wooden pavement, upon an improved principle, should be referred to the committee, and that the final decision upon the experiments should be deferred to the first Saturday in September. C. E. & Arch. Jour.

Birmingham Railway Signals,

Every station is furnished with an alarum, to give notice of the approach of each train, and to summon the whole of the men to their appointed places. These alarums are so constructed, that a weight is wound up after they have performed their office which prepares them to perform it again. On seeing that the forthcoming train has reached the proper spot, the policeman stationed at them pulls a trigger, and the weight begins to descend, ringing a loud gong-shaped bell by means of internal machinery. Bells are also hung so as, in a few seconds, to collect together the whole of the men belonging to the station, for any required purpose.

The police are placed along the line at distances varying from one to three miles, according as local circumstances rendered it necessary. Each man has his beat and duties defined, and is provided with two signal flags, one of which is red and the other white: the white flag is held out when no obstruction exists; and, on the contrary, the red flag indicates that there is danger, and that the train must not pass the signal till it is ascertained that the cause of danger is removed.

Each policeman, also, is furnished with a revolving signal lamp, to be used after dark; which shows, at the will of the holder, a white light when the line is clear; a green one when it is necessary to use caution, and that the speed of the train be diminished; and a red light, to intimate the necessity of immediately stopping.—*Roscoe's London and Birmingham Railway.* Ibid.

Clifton.—Somersetshire.—Enlargement of the Village. Brunel's Suspension Bridge.

There is, both in the village and out of it, enough going on to show that the building art does not lie idle. There is an evident growth of houses, which, like most of their predecessors, are very superior to the dingy-looking brick fronts in London, which almost stare us out of countenance. They approach more to the first-rate houses in Regent's Park, or in the city of Bath. Indeed, it has been said (*Beauties of England and Wales,*) that the Upper Crescents, particularly the terrace of the largest (which, together, form so conspicuous a feature,) can hardly be rivalled by any street in England. But from the village let us stroll to the Downs. Here is a series of villas just completed, in the plain Athenian style of architecture; and the grounds too, adjoining, are laid out in a tasteful manner. Not far from this spot, we may see the fruits of all-conquering genius, although they are not yet brought to maturity; we may see how mankind have reached "the highest heaven of invention;" where all around is quiet and solitudinous, but where is here heard the hum of men from the factory at the foot of Leigh Wood, whence the awakening sound goes forth; and it is deeply interesting to watch an immense weight of material for the masonry of the butment of the suspension bridge, traveling up an inclined plane that descends from the summit of the rocks, full 800 feet high. And what a proud memorial of skill, when the iron that has come under the giant grasp of the steam-arm is made subservient to ends so beautiful and so useful! What feelings of admiration and delight will be raised in the breast of the beholder, when he surveys a safe way for millions, or more, stretched from rock to rock high up in the air; beneath which vessels, with their sails spread to catch the breeze, float fearlessly and swiftly for the good of his fellow creatures! How grand, how imposing, it will be, to see one of the greatest triumphs of art achieved and wrought into those bold and lofty rocks, which have been formed by the hand of Nature, and founded upon an immovable basis!—*Frederick Lush, Oct.*, 1838.

Arc. Mag.

Birmingham, Bristol, and Thames Junction, and the Pneumatic Railway.

We understand the patentees of Clegg's Pneumatic Railway have entered into an arrangement with this company to lay down 1¼ mile, on a single way of their line, the necessary apparatus of a tube, &c., to try the experiment with. The road is to be ballasted, and the necessary rails and apparatus laid at the sole cost of the patentees. They are to have eight months from the date of the agreement to complete and prove the experiment. If at the end of that time it succeeds, the railway company are to have the use of the patent gratuitously, paying, of course, the expense the patentees may have been at in laying down the way, if they shall choose to take it. If it does not succeed, the latter are bound to clear all off in eight days after the proof of failure. A more favourable agreement than this to the company cannot be conceived; and in our opinion the directors have acted most wisely in accepting it. If the invention succeed, they secure the benefit of it to the company free of all patentee charges; and if it fail, they lose nothing. In the meantime they will have one line of way to themselves if wanted. So confident, however, are the patentees of success, that they are going, we hear, to the expense of about 14,000*l.* in the experiment. Our wish would be that they may succeed, but we must confess success on the whole length of this line, 2 or 3 miles, would not perfectly convince us of its success on a line of 30 or 100 miles long, for the reasons stated in our Number 41. The experimental way is to be carried up to, and beyond, the crossing of the Great Western line, so as to show the effects of a break in the apparatus. If, indeed, the Directors require it, it must also be continued up to the junction of the Birmingham Railway. A part of the line on which the experiment is about to be tried, has a gradient of forty-four feet per mile.

Rail. Mag.

Preserving Wood by Lime-water.

Sir,—Some years ago I called the attention of the readers of your instructive periodical to Sir Charles Stewart Menteith's (of Closeburn, Dumfrieshire) simple unpatented method of preserving timber; I think it so valuable a process, that it cannot be too often published. It is as follows: after cutting the timber to the size it will be wanted, it is steeped in a pond of lime and water for a fortnight, or more or less time, according to the size of the wood. Sir Charles has now some farm buildings on his estate, the timber in the roofs of which is the common young Scotch fir, but having undergone the lime-water process, it is as sound (after a lapse of forty years) as the day it was put up; the same timber, under ordinary circumstances, and in similar situations, would rot in from three to seven years. The carpenters find, in working the wood thus treated, that the edges of their plane-irons soon become dull; on examination, it is found that the acid contained in the wood is crystallized by combining with the alkali of the lime.

Yours faithfully, ARTHUR TREVELYAN.

Mech. Mag.

D'Harcourt's Patent Artificial Granite Blocks.

The attention of a meeting of the Institute of Civil Engineers having been called to M. D'Harcourt's artificial granite for railway blocks, and other purposes, Mr. Rastrick remarked that he had, about a month ago, laid down blocks of the Scotch Asphalte, two feet square, on a portion of the Southampton Railway. The sleeper was put in while the block was formed. It was usual to bore holes and to fix the chairs by bolts; he had wished to ascertain how far the blocks would stand the driving in of the bolts, without any boring; they bore this without any apparent injury, and he thought these blocks, weighing about 3 3-4 cwt., would answer the purpose better than blocks of other materials. Ibid.

Mechanics' Register.

Daguerre's Photography.

A few days since M. Daguerre exhibited, in one of the rooms attached to the Chamber of Deputies, several specimens of the products of the Daguerreotype. Among them were views of three streets of the capital, the interior of M. Daguerre's atellier, and a group of busts in the collection of the Louvre. The deputies who examined them, and who continued to crowd the room throughout the day, were particularly struck with the marvellous minuteness of detail which these views, and especially those of the streets, exhibited. In one, representing the Pont Marie, all the minutest indentations and divisions of the ground, or the building, the goods lying on the wharf, even the small stones under the water at the edge of the stream, and the different degrees of transparency given to the water, were all shown with the most incredible accuracy. The use of a magnifying glass revealed an infinity of other details quite undistinguishable by the naked eye, and more particularly in the foliage of trees. The antique busts are said to have been rendered by this method with very great beauty of effect. The chemical substance upon which the light acts, according to M. Daguerre's method, is laid upon sheets of copper, which, for the drawing exhibited on Saturday, were about nine or ten inches by six or seven inches. The expense of such plates M. Daguerre estimates at about 3 fr. 50c. each, but he expects that considerable reductions may be ultimately made in their cost, and that the improvement of his method will render it applicable to other substances not metallic.—*Galignani.* Ibid.

Average Value of the Annual Mineral Product of Cornwall and Devon.

If we estimate the value of the metals annually raised in Great Britain and Ireland, at about 10,597,000*l.*, and consider that of this sum the iron amounts to 8,000,000*l.*, the value of the remaining metals would be 2,597,000*l.*, of which Cornwall and Devon would furnish about 1,340,000*l.*, or more than one-half, leaving 1,257,000*l.* for the value of all the metals, with the exception of iron, raised in other parts of the United Kingdom. The two great metallic products of the district are copper and tin; of the former it yields one-third, and of the latter nine-tenths, of the whole supply of copper and tin furnished by the British Islands and all the countries of the continent of Europe.—*Geological Report*, 1839. Min. Rev.

The Locomotive Engine.

With sufficient coals and water in his manger, this iron horse can carry every day for ten hours, at the rate of sixteen miles an hour, the weight of an army of 21,504 men; whereas a good horse could not, at the same pace, and for the same distance, carry every day more than one man. For eighty miles he can carry the weight of 2688 men at a rate that neither the hare, the antelope, nor the race-horse could keep up with. No journey ever tires him; he is never heard to grumble or hiss but for want of work; the faster he goes the more ravenously he feeds; and for two years he can travel without medicine or surgery. It requires, however, about 2000*l.* a year to support him. By the invention of the locomotive engine, man has surpassed in speed every quadruped on the globe. Quar. Rev.

Fossil Bones.

A collection of fossil bones has been sold during the week by the Messrs. Stevens; the principal purchasers were the British Museum, the College of Surgeons, Professors Buckland and Sedgwick. The prices of the rarer lots were:—Bones of the mastadon: sides of the lower jaw, containing two molars, symphysis perfect, 1*l.* 12*s.*; a portion of the skull, with upper jaw, containing 4 molars, a very fine and perfect specimen, 4*l.*; fragment of the lower jaw, with molar, in fine preservation, 1*l.* 10*s.*; the left ramus of the lower jaw, of gigantic dimensions, with 2 molars, 2*l.*; the right ramus of ditto, with ditto, apparently of the same individual, 2*l.* 2*s.*; the cranium, with sockets for 2 molars, length from occiput to end of socket of tusk, 44 inches, diameter across at orbit, 28 inches, girth at occiput, 91 inches, weight upwards of half a ton, 153*l.* 6*s.* The lower jaws of the young hippopotamus, with the teeth very perfect, 2*l.*; very fine specimen of the lower jaw of a ruminant, 9*l.* 10*s.* Lon. Athen.

LUNAR OCCULTATIONS FOR PHILADELPHIA, DECEMBER, 1839.

Angles reckoned to the right or westward round the circle, as seen in an inverting telescope.
☞ For direct vision add 180° ☜

Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
12	8	16	Im. λ Aquarii	4	129°	166°
12	9	22	Em.		303	347
12	9	33	Im. 78 "	6	133	178
12	10	34	Em.		293	342
19	17	49	Im. C Tauri	4.5	75	129
19	18	39	Em.		268	317
21	8	21	N. App. ☽ & κ Gemin 4, ☽ North 3.'4			
24	10	7	Im. ρ Leonis	4	49	359
24	11	4	Em.		263	211
27	15	4	Im. ψ Virginis	5.6	22	342
27	16	8	Em.		262	232

Meteorological Observations for June, 1839.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction.	Force.		
				Inch's	Inch's			Inches.	
	1	52	66	29.65	29.65	W.	Moderate.		Cloudy—do.
	2	50	65	.65	.70	E.	do.	.25	Partially cloudy—do.—rain.
	3	54	66	.65	.65	E.N.	do.		Cloudy—clear.
☽	4	56	64	.70	.70	E.	do.		Cloudy—do.
	5	50	58	.65	.66	E.N.W.	do.	1. 5	Rain—cloudy.
	6	49	75	.75	.80	W.	do.		Clear—do.
	7	55	79	.95	30.00	W.	do.		Clear—do.
	8	60	79	30.00	.00	W.	do.		Clear—do.
	9	65	79	29.70	29.70	W.	do.	.25	Cloudy—shower.
	10	68	82	.70	.70	W.	do.		Clear—do.
⊗	11	68	83	.70	.70	W.	do.	.60	Lightly cloudy—shower.
	12	60	75	.80	.85	W.	do.		Clear—do.
	13	64	75	.85	.70	W.	do.	.23	Cloudy—shower—high wind.
	14	60	61	.75	.80	E.	do.	.6	Cloudy—drizzle.
	15	55	61	.80	.80	W.S.	do.		Partially cloudy—clear.
	16	58	73	.65	.70	W.	Brisk.		Clear—flying clouds.
	17	56	69	.80	.86	W	Moderate.		Cloudy—lightly cloudy.
☾	18	62	73	.80	.70	W.S.	do.	.6	Cloudy—rain.
	19	62	78	.60	.70	W.	do.		Clear—do.
	20	53	70	.80	.80	W.	do.		Lightly cloudy—clear.
	21	64	70	.70	.70	W.	do.		Cloudy—clear.
	22	70	85	.55	.55	W.	Brisk.	.1	Drizzle—clear.
	23	57	76	.75	.80	W.	Moderate.		Clear—do.
	24	56	73	.85	.86	W.	do.	.30	Clear—rain.
☼	25	56	64	.90	.95	W.	do.		Cloudy—clear.
	26	60	74	.95	.95	W.	do.		Clear—do.
	27	62	78	.85	.85	S.E.	do.	.50	Cloudy—rain.
	28	62	72	.65	.65	E.	do.	.5	Rain—clear.
	29	64	74	.70	.80	W.	do.		Cloudy—do.
	30	64	76	.90	.90	W.	do.		Clear—do.
	Mean	59.10	72.43	29.76	29.77			3.36	

	Thermometer.		Barometer.
Maximum height during the month.	85.	on 22d.	30.00 on 7th & 8th.
Minimum " "	49.	6th.	29.55 22nd.
Mean	65.765		29.765

JOURNAL
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MECHANICS' REGISTER.

NOVEMBER, 1839.

Practical and Theoretical Mechanics and Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Analysis of some of the Anthracites and Iron Ores found on the head waters of Beaver Creek; in the counties of Luzerne, Northampton and Schuylkill, Pennsylvania. By Walter R. Johnson, *Professor of Chemistry and Natural Philosophy in the Medical Department of Pennsylvania College, Philadelphia.*

In the course of some examinations in the summer of 1838, of the coal field lying partly in the county of Luzerne, and partly in Northampton and Schuylkill, I was, among other objects of interest, led to observe the explorations then in progress on the lands belonging to the Summit Coal Company and others, lying on the head waters of Beaver Creek, adjoining the property of the Beaver Meadow Coal Company.

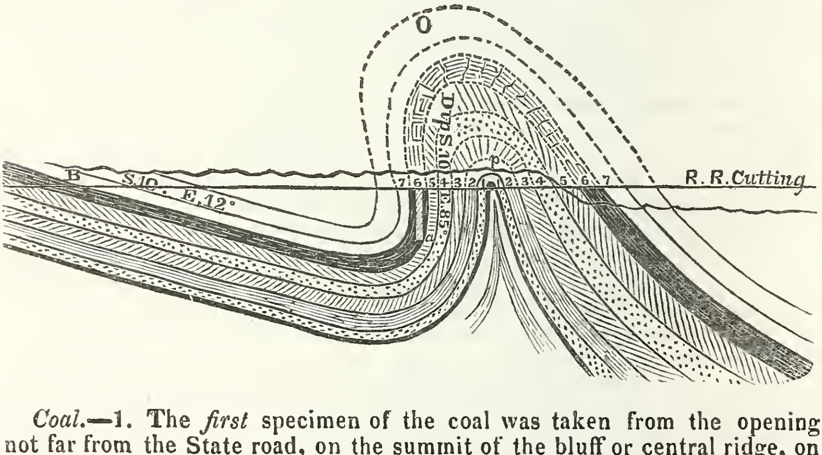
As the facts presented by those explorations appeared to afford solutions of certain questions relative to the position of the coal beds in that neighbourhood, I was induced to make a collection of such of the minerals as appeared important in that view, as well as indicative of the value of the coal for economical purposes.

I should premise that the lands of the Summit Coal Company are situated mainly on a swell or bluff of land, lying between Pismire mountain on the north, and Spring mountain on the south, forming near its eastern extremity a tapering ridge or "*point hill,*" between the north and south forks of Beaver creek; and at its western termination constituting a kind of table land, nearly as high as the tops of the two mountains above mentioned.

The circumstance in the character of the formation just referred to, is the general conformity of position in the coal beds in this part of the coal field with the prevailing figure of the surface of the ground. This is indicated first by the southerly dip of the beds on the south slope of Pismire hill and north of Beaver creek;—secondly, by the northern inclination of them where exposed on the north slope of the summit bluff;—thirdly, by the horizontal position found to prevail on the summit of the bluff; and finally, by the southern dip exhibited on the south slope of that bluff, to which may be added the northerly inclination of the strata in Spring mountain on its northern side.

The following sketch illustrates the view above given, and as it is derived from actual inspection and measurement of the coal strata, where they are exposed to view in a cutting formerly made for the railroad leading to the mines of the Beaver Meadow Coal Company, affords direct proof of the existence of more than one flexure in the Beaver Meadow coal trough. In this cutting there is displayed a nearly vertical bed of coal more than thirty feet in thickness; having, however, a real position or dip S. 10, E. 85°, and consequently a course or "strike" N. 80° E. In sinking a shaft in this vertical vein to a depth of 60 or 70 feet, it was ascertained that the inclination was changed to a northern dip; and the southern inclination at the surface of the ground was observed to continue southerly for one or two hundred yards, to a point where a thin seam of coal is seen to be cut through ust at the level where it comes to an upward flexure, and after passing to the south of that flexure, the whole series of rocks recurs in an inverse order from that which had been observed in approaching it. The dip also changes at this point from 85° to a much lower southerly inclination.

The doubling of the strata together is thus indicated, and the flexure of the large vein now worked, as exhibited from B to *a*, is rendered highly probable. The faintly marked portion of the figure between O and *p* represents the supposed portion of the upward flexure which has been carried away by denudation.



Coal.—1. The *first* specimen of the coal was taken from the opening not far from the State road, on the summit of the bluff or central ridge, on which the lands of the summit company are mainly situated. It is compact and shining; the black colour slightly inclining here and there to blue-black; the surfaces of deposition nearly obliterated, and the cleats or slines which generally part coal vertically, scarcely, if at all, perceptible. Hence the direction of the fracture appears indifferent, taking place in various ways promiscuously, with a form mostly conchoidal. Slight traces of iridescence are occasionally seen, indicating the presence of minute portions of protosulphuret of iron.

Its specific gravity is . . .	1.613	

It contains of water, ...	3.43	per cent.
Gaseous matter volatile at bright red heat, .	4.08	
Carbon not volatile by simple heat, . .	87.48	
Earthy matter, ...	5.01	
	100.00	

The ashes are of a fawn colour, of medium density, and contain the following ingredients in 100 parts, viz:—

Silica, ...	54.50	per cent.
Alumina, ...	34.45	
Peroxide of Iron, ...	7.50	
Lime, ...	2.25	
Magnesia, ...	1.30	
	100.	

Having been taken from near the outcrop of the bed, this specimen is to be regarded as a rather less favourable sample than would be probably found under a greater depth of covering.

2. The next specimen analyzed was from the northerly slope of the bluff, also near the State road. In many of its external characters it resembles the preceding, but is less prone to give conchoidal fractures, and its specific gravity is 1.594.

It contains of water, ...	3.26	per cent.
Other matter volatile at red heat . .	1.05	
Carbon, ...	91.69	
Earthy matter, ...	4.00	
	100.00	

The ashes of this specimen were likewise analyzed, and gave the following result, viz:

Silica, ...	50.25
Alumina, ...	38.90
Peroxide of iron, ...	8.75
Magnesia, ...	1.25
Lime, ...	0.85
	100.

3. The third variety of this coal which was subjected to analysis, came from an opening which was in progress at the period of my visit to the Beaver Meadow. It was taken from a shaft then sunk fifteen feet in a bed composed partly of black dirt and partly of solid coal. The sample was taken from the solid part near the bottom. It is like the foregoing in regard to the obliteration of its surfaces of deposition, has rather less of the bluish tinge in its colour, possesses a specific gravity of 1.630, and will consequently weigh 2750¼ lbs. per cubic yard, or nearly 1¼ ton.*

It contains of volatile matter,	9.6	per cent.
Carbon not volatilizable by simple heat,	85.337	“
Earthy matter,	5.063	“
	100.	

The ashes of this coal are likewise reddish-gray, varying but little in complexion from the preceding. The combustible *gas* given out in the distillation of this coal is of considerable amount, and indicates it as a fuel well adapted for use under steam boilers.

4. The *fourth* variety tried was taken from a pit on the north side of Beaver creek, and appears to be the third coal bed in the formation, reckoning from below, upwards. The inclination of this bed is to the south, and it accordingly dips under the bed of the creek. It is ten feet or more in thickness, and presents highly favourable indications as to facility in working. Its colour in fresh fractures is jet-black, shining. The form of fracture irregular, splintery; a striated appearance being occasionally observable.

Its specific gravity is 1.560. A cubic foot of it therefore weighs 97½ lbs. and a cubic yard 2632½, or about 1⅙ ton. Of this coal two analyses were made. By the first, I obtained of volatile matter, including

Water and combustible gases,	6.89 per cent.
Carbon, not volatile by simple heat,	91.64
Earthy residuum,	1.47
	100.00

The ashes are of a brownish-red colour, tolerably heavy, and have all the appearance of being derived from a regular *red-ash* coal.

The unusually small proportion of the earthy residuum given by the above trial, having induced me to suspect that some error might have occurred and escaped notice, I repeated the trial with the utmost attention, taking care to determine, separately, the water and gaseous combustible matter. From this repetition, I obtained,

Volatile matter, 6.42 per cent.	Water,	2.19 per cent.
	Gas, (carbonic oxide, carburetted hydrogen, and a little tar,)	4.23
Unvolatilizable carbon,		92.30
Earthy residuum,		1.28
		100.

From this it appears that the first trial on this sample was not certainly below the truth in regard to earthy matter.

The diversity between the two experiments is not so great as will often occur in trying specimens from the same coal bed. Either may be regarded as highly favourable to the character of the coal. I may be allowed further to remark, that of all the trials of anthracites of which I have any knowledge, either by my own experiments or those of others, the analysis just detailed, gave the least proportion of earthy matter, and even of bituminous and cannel coals, I have met with but one result among the many on record, which was even so low in the amount of its earthy impurities;

and yet I have no reason to believe that the sample which I picked up at random at the mouth of the pit, was of better quality than the average of the mass from which it was taken.

If the four varieties of coal be viewed together, ranged in the order of their specific gravities, beginning with the lowest, we have the following table of results :—

	Sp. gr.	Vol. mat.	Carbon.	Ashes.
1st. (No. 4.)	1.560	6.42	92.30	1.28
2d. (No. 2.)	1.594	4.31	91.69	4.00
3d. (No. 1.)	1.613	7.51	87.48	5.01
4th. (No. 3.)	1.630	9.60	85.337	5.063
Mean . .	1.599	6.96	89.452	3.838

From the above table, it will be perceived that the quantity of ashes increases as the specific gravity increases, and that the quantity of fixed carbon diminishes as the specific gravity increases. This might possibly not be found to hold good in all coal-fields, though I am inclined to think that in the same coal-field the relations of different plies will be found to confirm the same general law.

In comparing the results in the above table with those of other experiments on anthracite, I find the average amount of carbon much greater than has heretofore been assigned to that species of fuel.

Thus of twelve species of anthracite analyzed by Berthier, the mean

per centage of carbon was	79.15
Ashes, ...	13.25
Volatile matter, ...	7.37--99.71

It hence appears that while the quantity of volatile matter is widely different from that which I find as the average amount of the same material in the coal of the Summit Company, the proportion of ashes is nearly three-and-a-half times as great.

By a mean of seventeen trials on the coal of different beds at Tamaqua, Messrs. Bache and Rogers found the proportion of ashes 7.3 per cent., or a little less than twice as much as the average of my four analyses of the *summit* coal of Beaver creek.

No. 5. This specimen was taken from a pit opened on the lands of Cornelius Stevenson, Esq., on the northerly slope of the bluff above described, but not far from the top of the ridge. The bed has at this point a northerly dip, and consequently confirms the view above given in regard to the general arrangement of strata.

The coal is compact, shining, of a bluish-black; its specific gravity is 1.6127; a cubic foot of it will weigh 100.79 lbs., and a cubic yard 2721$\frac{1}{3}$ pounds.

When heated to redness, the specimen which I analyzed, and which was taken from the bed only a few feet from the surface of the ground, or outcrop of the coal, and was consequently more charged with moisture than the generality of the coal would be, gave of water at 550°, 5.68 per cent.

Combustible carbonic oxide, and a little carburetted hydrogen expelled at red heat, ...	3.55
Carbon, not volatilizable by simple heat, . . .	86.06
Earthy matter, ...	3.71
	100.00

The ashes of this coal are of a salmon colour, moderately light, and contain the following proportions of their several ingredients, viz:

Silica,	50.05	per cent.
Alumina,	29.04	"
Peroxide of Iron,	8.75	"
Lime,	1.56	"
Magnesia,	1.30	"
	99.70	

The small proportion of earthy matter found in this coal, with the very slight trace of sulphur observable during the combustion, mark it as properly adapted to the purposes of the founder and iron manufacturer, as well as to domestic consumption. I see no reason to doubt, that in all respects it will bear a favourable comparison with the best varieties of coal found in the district of country in which it lies. Few, if any, anthracite districts have fallen under my observation, which possess a less share of earthy ingredients. And viewing its relation to the anthracites of other countries, we may state that of twelve varieties of that fuel analyzed by M. Berthier, the result was found to be

In *Carbon*,	highest .913	lowest, .665	mean, .791
In *Ashes*,	" .249	" .027	" .732
In Vol. mat.	" .135	" .022	" .073

No. 6. This specimen of coal was from the lands of the Buck Mountain Coal Company, near the head waters of Laurel run, and at a distance of about five miles from the locality of those above described. It is in fact in the prolongation of that coal trough, in which the Hazleton and Sugar Loaf mines are situated, and is near the south-eastern extremity of the deposite. The bed there dips to the north in an angle of about fourteen degrees.

This sample came from the bed twenty-two feet in thickness, lying thirty or forty feet above the conglomerate rock which appears to be the boundary of the coal formation, and from the lowest ply, except one, in that bed. The thickness of this ply is over seven feet. The distance from the point where the mine is open, to the mouth of Laurel run, down which stream the course of a railroad leading to the Lehigh would lie, is about four miles.

The coal is compact, and of a nearly uniform black colour; shining; fracture uneven, splintery, indifferent in its direction, and seldom conchoidal in its form. Though the surfaces of deposition are discernible by the differences of colour, there appears to be no tendency to cleavage in the direction in which they traverse the coal. Its specific gravity is 1.559, and consequently one cubic yard will weigh 2630 pounds.

Its constituents are,—*water*,	0.390	per cent.
Gaseous matter, including some azote, volatile at bright red heat,	5.515	"
Carbon, not volatilizable by heat,	91.016	"
Earthy matter and oxide,	3.079	"
	100.	

The ashes are of a reddish-buff colour, rather light, and present some portions perfectly white. They yielded on analysis the following constituents, viz:

Silica,	45.60	per cent.
Alumina,	42.75	"
Peroxide of Iron,	9.43	"
Lime,	1.41	"
Magnesia,	0.33	"
	99.52	

The proportion of ashes in this coal is much below that of the average of the anthracites of Pennsylvania. Few even in that part of the central coal district, in which the Buck Mountain Company's lands are situated, will be found to yield either less earthy matter, or more fixed carbon, than the sample above analyzed.

Iron Ores.—The bed of iron ore from which the samples that I have examined were taken, is found on the southern declivity of the bluff, about forty rods northerly from the south fork of Beaver Creek, and judged to be about three-quarters of a mile from the Beaver Meadow Rail-road. With this road the locality can be connected at a very little expense by a branch road. Above the bed of ore is a seam of black dirt of considerable thickness, judged to be the remains of a bed of coal which may possibly be found unaltered at no great distance.

The thickness of the bed of ore and shale is seven feet, and it lies seventeen feet beneath the surface of the ground at the point where it is opened. The inclination of the bed is to the south, but apparently less rapid than that of the surface of the hill, so that if the dip observed in the shaft be maintained for any considerable distance below the present opening, there is reason to suppose that it would *crop out* before coming to the border of the creek. The covering is composed of

3	feet of	Earth—surface soil,
6	"	Black Dirt,
8	"	Slate,
7	"	*Ore* and Slate,
1	inch of	Coal,
17	feet of	Sandstone.

The first variety which was analyzed gave by the usual assay in the dry way, the following composition, viz:

Water expelled at 250°,	00.4	per ct.
Carbonic Acid,	26.6	"
Cast Iron,	33.8	"
Earthy matter,	26.64	"
Oxygen,	12.55	"
	99.99	

This variety of the ore has a light bluish ash colour, is moderately tough before calcination, and possesses a specific gravity of 3.247; consequently, a cubic yard of it would weigh 5469 lbs. or 2.44 tons.

The pig metal given in the above assay is soft, tough, and of a dark gray colour, apparently well suited for foundery purposes.

The cinder is a transparent, nearly colourless, glass,—very fusible and contains but few adhering particles of metal.

The employment of pure carbonate of lime as a flux in the proportion of one part of this metal to six parts of raw mine will produce a complete reduction of the ore and fusion of the earthy ingredients. In using the anthracite No. 5, above described, a small addition of limestone, to the amount of one per cent. of the coal employed, may be found requisite in order to insure an equally complete fusion of the earthy residuum of the fuel. Assayed in the humid way this ore yields the following results, viz:

	per ct.
Water, ...	00.40
Carbonate of Iron, ...	63.20
Carbonate of Lime, ...	2.50
Carbonate of Magnesia, ...	2.27
Oxide of Magnesia, ...	2.00
Silica, ...	17.50
Alumina, ... : .	10.55
	98.42

The above quantity of carbonate corresponds to 39.1 per cent. of protoxide, or 30.45 per cent. of pure metallic iron which is 3.35 per cent. below the above yield in *pig metal*, or it is 9.9 per cent. of the pig metal itself, to be regarded as pure iron matter; which is probably very near the true average amount according to the latest and best analyses. The yield in *iron* is equal to the average of Scotch ores in the neighbourhood of Glasgow.—The latter have a specific gravity of 3.209, according to Dr. Colquhoun. This ore which is the blue clay iron-stone of the coal measures, has therefore the specific gravity, the degree of richness, and the fusibility of the same class of ores found in bituminous coal fields, and there is no doubt, in my mind, that it may be easily and profitably worked.

The second variety of the ore examined, was a sample from the same locality, but from a different part of the bed from that in which the preceding was found. It is of a reddish-brown colour, except the exterior, which is yellowish-red.

The specific gravity of this variety is 2.896.

Assayed in the dry way it gave,		
Water,	13.12	per cent.
Pig metal,	44.96	"
Earthy matter,	24.804	"
Oxygen,	17.11	"
	99.994	

Of the earthy impurities, there were found insoluble in acids 18.55 per cent. The ore now under consideration, has apparently undergone a change by atmospheric influences, from the condition of a carbonate of the protoxide of iron to that of a hydrate of the peroxide; it is not remarkable that in passing from one of these states to the other, some of the earthy ingredients should have been washed away. The usual tests of lime failed to detect that substance. The cinder had a smoky-gray colour, translucid on the edges, and was a compact glass, moderately fusible.

As the appearance of the cinder indicated, particularly when tested before the blow pipe, and by acid, that some portions of metallic oxide still remained in it, an analysis of this ore was also made in the humid way, which gave the following results, viz:

Water,	13.12	per cent.
Peroxide of Iron, with trace of manganese,	63.65	"
Silica,	13.45	"
Alumina,	8.77	"
Magnesia,	1.01	"
	100.	

The quantity of peroxide of iron corresponds to 44.55 per cent. of *iron*, or .41 per cent. less than that of the metal actually obtained. Hence it appears that the quantity of iron remaining in the cinder is very nearly equal to that of the carbon, &c. in the pig metal.

There seems, from all the above statements, to be no reason to doubt that when brought into use, this ore will prove every way competent to sustain a character equal to that of any other argillaceous carbonate of iron, whether of the bituminous, or the anthracite coal districts. I am not aware that the samples which I took from the mouth of the pit were other than fair representatives of the general character of the bed from which they were raised. It is probable that when explored so far as to be under an extensive solid covering, it will be found to correspond more nearly to the character indicated by the former than to that given by the latter of the above analyses.

Near the second bed of coal opened on the slope of the hill north of the northern branch of Beaver creek, I found some iron ore thrown out in excavating a coal shaft. It was all in the state of brown hydrate, and though too much exposed near the surface to allow of the formation of any just estimate of its quantity in the solid part of the bed, where, doubtless, it will be found in the state of a carbonate, yet the size of the specimens which I observed, and their structure, led me to suppose that it could not belong to a trivial, or chance, deposite. This opinion is strengthened by the fact that a bed of seven feet in thickness of iron ore and iron slates is found, as already described, on the opposite side of the bluff, and not more than a mile distant.

The ore submitted to analysis, is of a brown, or yellowish-brown. colour, compact, with small shining particles. Its specific gravity is 3.555.

At a temperature of 330° it loses in moisture,	0.55	per cent.
By strong calcination, it loses of water,	10.048	"
It contains of Peroxide of iron,	71.12	"
Earthy impurities,	18.382	"
	100.	

Of the earthy matter, 13 per cent. are insoluble in acids, being chiefly silica, and 5.382 per cent. are alumina and magnesia; no lime was detected; and but a trace of manganese.

The quantity of pig metal obtained in my analysis was 49.77 per cent.; its colour dark gray; structure crystaline, granular. It was soft, tough, and well adapted for foundery purposes. The cinder was a perfect glass, translucent on the edges, of a smoky colour, readily fusible before the blow-pipe, and, consequently, it presents no obstacle to the free running of iron in a furnace. The result of this trial is such as in my opinion, to justify a careful examination to ascertain the quantity of ore to be obtained in this locality. Being in the immediate vicinity of the richest of the coals above described, it will be a highly valuable resource, if it shall be found in beds of such thickness, and with such accompaniments, as to render its attainment not too expensive. This point will be determined only by actual searches.

Notice of the advances made in the Science of Mineralogy during the year 1837. *From the Report of Berzelius to the Swedish Academy.*

(Continued from page 221.)

On Minerals already known.—In the year 1760 was discovered, in the ground on which the city of Montpellier is situated, metallic mercury, and as this did not agree with the opinions respecting its ordinary localities, recourse was had to the absurd explanation, of its originating from the large amount of mercurial preparations employed for the syphilitic diseases in the Hospitals. *Marcel de Serres* has proved* that mercury occurs not only in the strata under the town, but in those of the neighbourhood, and thinks that the barrenness of the soil may be attributed to this cause. It does not exist in the uppermost stratum, which consists of sea sand, and incloses organic remains; but under this, and resting upon a tertiary lime-stone, is a stratum of yellowish, argillaceous marl, in which globules of the metal are sparsely distributed, without a trace of cinnabar. The quantity is too small to be worth its extraction for the arts.—M. de S. believes that it arises from sublimation from lower strata both there and at other places. But in this case it would not be confined to a certain stratum.

Glocker† met with crystals of Arseniuret of Nickel (copper-nickel) sufficiently distinct to be recognized, but not for measurement. Their form is that of a cube, and he concludes that they belong to the rhombohedro-dihexahedric system, and like crystals of peroxide of iron and corundum, that they constitute a transition from the former to the latter.

Sander‡ analyzed a native sulphuret of silver and copper, a silver-copper-glance crystalizing in the form of sulphuret of copper, which occurs at Rudelstadt in Silesia. It consists of:

Silver,	52.71
Copper,	30.95
Iron,	0.24
Sulphur,	15.92
	99.82 = $Cu^2 + Ag\,S$.

Its crystaline form is viewed as one of those circumstances, which apparently prove, that what has hitherto been received as the weight of one atom of silver is properly the weight of two atoms, for it cannot be otherwise explained how it should be isomorphic with sulphuret of copper = $Cu^2\,S$.

Rammelsberg§ analyzed a hyposulfantimonite of iron (Berthierite) from the new mine, Hoffnung Gottest, at Braunberg, near Freiberg. The result was:

Iron,	11.432
Manganese,	2.544
Zinc,	0.737
Antimony,	54.700
Sulphur,	31.326

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* An. de Ch. et de Phys. LXV. 286.

† Jour. für pract. Chemie, XII. 182.

‡ Poggend. Annal. XL. 313.

§ Poggend. Annal. XL. 153.

corresponding to the formula—$FeS + Sb^2S^3$, in which a little iron is replaced by manganese and zinc.

Thaulow[*] analyzed a basic hyposulfantimonite of lead, (Boulangerite) from Nasafjäll in Lappmark. It closely resembles certain kinds of native sulphuret of antimony, but has a lighter color. It consists of:

Lead, ...	55.57
Antimony, ...	24.60
Sulphur, ...	18.86

corresponding to the formula $(PbS)^3 Sb^2 S^3$, and therefore proportional to ruby silver ore.

The same mineral was described by *Breithaupt*[†] under the name of Plumbostib, and probably the same as Embrithite. The latter is not fibrous, but massive and fine grained. Both varieties were found in the mine Algatschinski near Nertschinsk.—What a host of ingeniously contrived names some reformer in mineralogy will be obliged to banish at a future period!

Zinken[‡] described a mineral from San Antonio, near Copiapo, in Chili, belonging to the same class of sulfantimonites and sulfarsenites. It has a metallic lustre, is colorless, and either tubular, kidney form, or wart form. It contains copper with antimony, arsenic and sulphur.

Jordan[§] analysed an arsenical iron pyrites from the mine Felicitas near Andreasberg, which deserves attention on account of its composition. It occurs in quartz in the form of fine white, needle-shaped crystals with a metallic lustre, and yielded in the analysis of a specimen mingled with quartz:

Arsenic, ...	19.906
Iron, ...	13.105
Sulphur, ...	3.078
Silver, ... :	0.004
Quartz, ...	64.000
	100.183[‖]

It is distinguished from Mispickel by a less amount of Sulphur. Jordan proposes for it the formula $FeS + Fe^3 As^3$.

Scherer[**] examined two Cobalt-minerals from Modum in Norway, which are distinguished from ordinary Cobalt-ore by their crystaline form. One of them is in the form of an Octahedron combined with the cube, dodecahedron and icositetrahedron, has a silver-white color,—a sp. gr. 6.78, and by roasting in a tube before the blow-pipe yields a rose-red powder. It consists of:

Cobalt, ...	20.01
Iron, ...	1.51
Arsenic, ...	77.84
Sulphur, ...	0.69
Copper, ...	a trace
	100.05 $= Co As^3$.

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[*] Poggend. Annal. XLI, 216.

[†] Jour. für pract. Chemie X, 442.

[‡] Poggend. Annal. XLI, 659.

[§] Jour. für pract. Chemie X, 436.

[‖] There is evidently some error in the figures of the report. Tr.

[**] Poggend. Annal. XLII, 546.

The other has the form of arsenical iron (rhombic) with a trifling difference in the angles; indeed it is an arsenical iron pyrites in which about one-fourth of the iron is replaced by cobalt, not, however, in a constant ratio, but inversely as the dimensions of the crystals; so that in a very large one, it amounted only to one-fifth. It behaves like arsenical iron before the blowpipe, and after roasting on the glass leaves red peroxide of iron.

Dove[*] made some important researches on the unequal influence exercised by quartz in the polarization of light according to its various forms. They resulted in their division into three classes:

1. Those which turn the plane of polarization to the right;
2. To the left; and
3. Those combining the two, and these either,
    - *a*, Turning to the right with places where they act like combined plates, or positive one-axis crystals;
    - *b*, Left turning with similar places;
    - *c*, Amethysts, which on certain parts act like those turning right, on others like those turning left, and on intermediate points like positive one-axis crystals.

Dufresnoy[†] analysed Diaspore from Siberia and found it composed of:

Alumina,	74.66
Peroxide of Iron,	4.51
Lime and Magnesia,	1.64
Silica,	2.90
Water,	14.58
Loss.	1.71
	100.00

from which he calculates its composition as $A^5 Aq^2$. He views the silica as accidental, and the oxide of iron as altogether foreign, because it may be extracted by muriatic acid without affecting the mineral. He further analysed an older Diaspore from an unknown locality and found in it:

Alumina,	78.93
Peroxide of iron,	0.52
Lime,	1.98
Silica,	1.39
Water,	15.13
Loss,	2.14
	100.00,[‡]

for which he gives the same formula. Notwithstanding the formula is supported by the analysis, it can hardly be received as the true one, for it supposes $6 H^{2}0 + 5 Al^{2} 0^{3}$, and seems to point out one atom of water as belonging either to the silicate of lime alone or that it is also hygroscopic. In that case it becomes the natural formula of $H^{2}0 + Al^{2} 0^{3}$, as *Hess* proved of the mineral purified by acid (see Annual Report, 1832.)

Tamnau[§] examined with accuracy the grounds which induced *Quenstedt* to suppose (An. Report, 1837) that the soap-stone mineral at Snarum in Norway, forming pseudomorphic crystals in serpentine and resembling

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[*] Poggend. Annal. XL, 607.

[†] Jour. für pract. Chemie XL, 129.

[‡] Again a slight error in the figures. Tr.

[§] Poggend. Annal. XLII, 462.

Olivine or Chrysolite in form are only decomposed Olivine. He thinks the supposition improbable, and believes that crystals of chrysolite have been removed and the cavities filled with the same substance which constitutes the surrounding formation, viz. Serpentine.

A mineral from Nontron, mentioned in the Ann. Report for 1829 and called Nontronite by Berthier, was found in an iron mine near Andreasberg, and analysed by *Biewend*,[*] who found its composition to be:

Silica, ...	41.10
Peroxide of Iron, ...	37.30
Water, ...	21.53
	99.96

It is therefore $F S^2 + 2 Aq$, but the too small amount of water as well as a slight excess of oxide of iron, taken in connexion with the frequent greenish color of the mineral, prove that it must contain a corresponding hydrated silicate of protoxide and peroxide of iron.

The same mineral has been found not far from Autun, in France, and analysed by *Jacquetain*[†]. He found it to consist of:

Silica, ...	41.31
Peroxide of Iron, ...	35.69
Alumina, ...	3.31
Oxide of Copper, ...	0.90
Oxide of Zinc, ...	a trace
Lime, ...	0.19
Water, ...	18.63
	100.03

He calculates the formula $A S^7 + 7 F S + 11 Aq.$, which, theoretically, is highly improbable. The preceding analysis appears to place it beyond a doubt that the mineral is a hydrated silicate of peroxide of iron, which contains a small quantity of some foreign minerals, in both of the French varieties.

COMMITTEE ON MINERALOGY OF THE FRANKLIN INSTITUTE.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Observations on the Annular Eclipse of September, 1838. *By* J. BLICKENSDERFER, Jr., Esq.

To the Committee on Publication:

Gentlemen—I send you for insertion in the Journal of the Franklin Institute, if deemed expedient, an extract from a letter recently received from Mr. J. Blickensderfer, Engineer in the service of the state of Ohio, communicating his observations of the Annular Eclipse of the Sun, of the 18th Sept., 1838, Dover, Tuscarawas county, Ohio, together with those of two of the Pleiades on the evening of the 27th December, of the same year.

Yours, &c.

Philadelphia, Oct. 29, 1839. SEARS C. WALKER.

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[*] Poggend. Annal. XLI, 162.

[†] Annales de Ch. et de Phys. XLVI, 101.

Roscoe, Ohio, October 16, 1839.

To Sears C. Walker,

Dear Sir—Your favor of the 20th ult. has been duly received, together with the High School Observations of the eclipse of 18th September, 1838, and a number of the proceedings of the American Philosophical Society, for all of which please accept my thanks. The information rendered is highly satisfactory, and the offer of interchanging observations gladly accepted.

My observations are few, being unable to make them except when leisure from business permits, and from my inferior instruments and limited means they will not bear comparison in point of accuracy with those made by persons in more favourable circumstances. Still they may possess some additional interest from fixing, at least approximately, the geographical positions of not merely one, but various places; for being engaged in the engineer service of the state, my station is necessarily often changed. My observations of the eclipse of Sept. 18, 1838, were not made here, but in Dover, Tuscarawas county, Ohio. Last year while engaged on the Walhonding Canal, I suffered from a severe attack of sickness, which forced me to quit my station and return to Dover (the residence of my father,) to recover my health, and it was there during my convalescence that they were made. The latitude was determined by observations on the sun and different fixed stars about the time of their meridional passage. Each of these observations consisted of a series of altitudes, generally between 20 and 30 in number, taken nearly equally on each side of the meridian, the corresponding times being noted and thence the reduction calculated and applied as a correction to the mean of the altitudes. The instruments used were a brass sextant of eight inches radius, graduated to 15″ on a silver limb, by Whitbread, London; and a superior, mercurial, artificial horizon with a glass roof. The mean of ten series of such observations give for the latitude of Dover 40° 30′ 52″ N. These were all made on objects south of the zenith, and I regret to state that circumstances would neither permit me to multiply the number, nor take any towards the north, for correcting the errors of the Instrument, if any. I am inclined to believe, however, from my use and examination of the Instrument, that its glasses are good, and the errors of graduation small; we may, therefore, consider the result above as being within a few seconds of the truth.—The 18th was a day in every way favourable for observation, perfectly cloudless except for a short time between the rupture of the ring, and the end of the eclipse. The corrected mean times of the several phases are as follows, as observed at Jacob Blickensderfer's house in Dover.

Beginning, . .	2h.	39m.	38.82s.
Formation of Ring, . .	4	00	25.71
Rupture of Ring, .	4	6	9.63
End, ...	5	18	3.64

The telescope used was a twenty inch achromatic, power 20. The error and rate of the clock were determined by eastern and western altitudes of the sun and stars taken on the day of the eclipse and for several days before and after, by the sextant. The clock is not a superior one, yet the rate was uniform to a fraction of a second, and every care was taken to make the observations as good as the instruments would render; and making due allowance for the quality of the Instruments, the observations are good.—On the 27th Dec., 1838, I observed, at the same place, with the same Instruments, the two following occultations, viz:

η Pleiadum Im. 7h. 29m. 19.80s. } Mean time.
f " Im. 8 15 3.00 }

The clock was regulated in the same manner as for the eclipse, and the observations are likewise satisfactory. These are all the observations made in Dover; I have two more made in Roscoe, but as I have not yet determined the latitude, I defer sending them at present. They were on b Pleiadum, Sept. 26th, 1839, and on τ Sagittarii, Oct. 14.

Respectfully,
J. Blickensderfer, Jr.

Practical description of the process called the Daguerreotype, which consists in the spontaneous reproduction of the images of natural objects, in the Camera Obscura; not with their colours, but with great delicacy in the gradation of the tints. By Daguerre.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. F. FRAZER.

Description of the Process. The drawings are made upon thin sheets of silver, plated upon copper. Although the copper serves principally to support the plate of silver, the union of these two metals promotes the perfection of the result. The silver should be as pure as possible; as for the copper, its thickness should be sufficient to maintain the plane of the silver in order that the images may not be deformed, but we must avoid giving it more thickness than is necessary to attain this end, on account of the weight resulting from it. The thickness of the two metals should not exceed that of a stout card.

The process is divided into five operations.

The first consists in polishing and cleaning the plate, so as to render it fit for receiving the sensitive coating.

The second, in applying this coating.

The third, in submitting the plate thus prepared, to the action of the light in a camera obscura, in order to receive upon it the picture from nature.

The fourth, in causing this picture to appear; it not being visible when first taken from the camera obscura.

Finally, the fifth has for its object, the removal of the sensitive coating which would continue to be modified by the light, and would tend necessarily to destroy the impression altogether.

First Operation. This requires a small flask of olive oil; very fine carded cotton; pumice ground exceedingly fine, tied up in a piece of muslin sufficiently thin to suffer the pumice to pass through it easily, when shaken; a bottle of Nitric Acid diluted with water in the proportion of one part (by measure) of acid, to sixteen parts (by measure) of distilled water; a frame of iron wire upon which the plates are put in order to heat them by means of a small spirit-lamp; and finally a small spirit-lamp.

As was before mentioned the drawings are made upon silver-plate. The size of the plate is limited by the size of the apparatus. It must in the first place be well polished. For this purpose, it is sprinkled with pumice (shaking it without touching the plate) and is rubbed gently, in a circular direction, with cotton soaked in a little olive oil. In this operation the plates are laid upon a sheet of paper which must be renewed from time to time.

The pumice is re-sprinkled and the cotton renewed several times. The mortar employed for pulverizing the pumice should be neither of cast-iron nor of copper, but of agate; it should then be levigated upon ground-glass with a glass muller, using very pure water, and should not be employed until perfectly dry. It may be conceived how important it is that the pumice should be so fine as not to scratch, since it is upon the perfect polish of the plate, that the beauty of the picture, in a great measure depends. When the plate is well polished it must be freed from the oil, which is done by sprinkling it with pumice and rubbing it dry with cotton, rubbing always in curves; a good result cannot be obtained by rubbing otherwise. A small plug of cotton is then made, which must be wet with a little acid diluted with water as above mentioned. To accomplish this, the plug is placed in the mouth of the bottle, and the whole turned upside down, pressing lightly upon it, so that the centre only of the plug may be wet with the acid, without being deeply impregnated with it; very little is wanted, and care must be taken to avoid wetting the fingers. The plate is then rubbed with the plug, taking care to spread the acid perfectly over the whole surface of the plate. The cotton is changed, and the plate again rubbed, always in circles, so as to spread completely the film of acid, which should, however, merely touch, as it were, the surface of the plate. It will happen that the acid when applied upon the surface of the plate will separate into globules which can only be destroyed by changing the cotton, and rubbing so as to spread the acid very evenly; for the places where the acid has not taken will cause blurs. The acid is known to be very equally spread, when the surface of the plate is covered with a regular veil over all its extent. The plate is then sprinkled with pumice and rubbed very lightly with fresh cotton.

The plate must then be submitted to a high heat. For this purpose it is placed upon a frame of iron wire, raised to a proper height by legs, the silver above, and the spirit-lamp is passed backwards and forwards along the under surface of the plate, so close that the flame may be broken upon it. After having passed the lamp for at least five minutes under every portion of the plate, a light, whitish coating forms upon the surface of the silver.—The action of the heat is then withdrawn. The heat of the lamp may be replaced by that of a charcoal furnace, which is even preferable, as the operation is sooner finished; in this case, the wire frame is useless, since the plate is laid upon the tongs, the silver above, and moved backwards and forwards over the furnace so as to heat every part equally, until the silver becomes coated with a light, whitish, surface as has been explained. The plate is then quickly chilled by placing it upon a cold surface, such as a marble table. When it is cold it must be again polished, which is quickly done, since it is only necessary to remove the whitish coat which has formed upon the silver. For this purpose the plate is sprinkled with pumice and rubbed dry with a cotton plug; the pumice is frequently resprinkled, taking care to change the cotton often. When the plate is well burnished, it is rubbed, as above mentioned, with the acid diluted with water, sprinkled with a little pumice, and rubbed very lightly with a plug of cotton. The acid must be renewed three times, taking care each time to sprinkle the plate with pumice, and to rub it dry, very lightly, with very clean cotton, taking care that the part of the cotton touched by the finger shall not touch the plate, since the transpiration would cause blurs upon the drawing. The humid vapour of the breath must also be avoided, as well as drops of saliva

When it is not intended to operate immediately, the acid is used but twice after the operation of the heat, by which means we may prepare our work before hand, but it is absolutely necessary, when about to commence a drawing, to renew the acid at least once, and to pumice lightly as described above. The pumice dust which is on the surface and edges of the plate is then brushed off with very clean cotton.

Second Operation. For this operation we must have,

The box figured in fig. 1.

A rectangular frame of wood.

Four small metallic strips of the same nature as the plate.

A small hammer and a box of small nails.

A little Iodine.

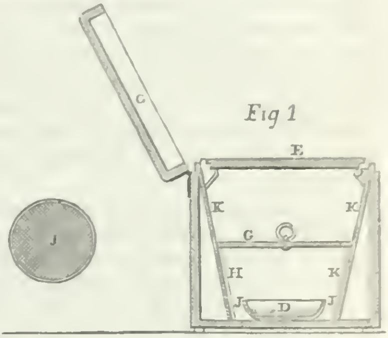


Fig 1

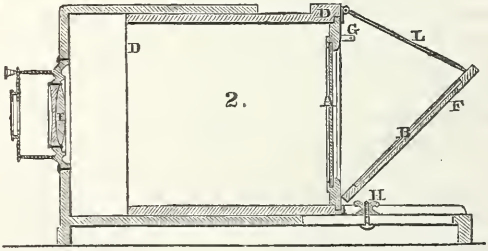
After the plate has been fixed upon the frame by means of the metallic strips and small nails which are driven with the hammer designed for that purpose, the iodine must be placed in the capsule which is at the bottom of the box. The iodine must be divided in the capsule in order that the focus of emanation may be larger, otherwise, an iris would form at the centre of the plate which would prevent the obtaining an uniform coating. The wooden frame is then placed, the metal downwards, upon the small brackets fixed at the four angles of the box, and the cover is shut. In this position it must be left until the surface of the silver is covered with a perfect coating of a golden yellow colour. If it be left too long, this golden coating will pass to a violet colour, which must be avoided since the coating is then not so sensitive to the light. If on the other hand the coating be not sufficiently yellow, the image would be produced with great difficulty. So that the yellow must be of a well defined shade, this being the only one which is favorable to the production of the effect. The time necessary for this operation cannot be determined, for it depends upon several circumstances; in the first place upon the temperature of the room, for this operation ought always to be left to itself; that is, it ought to go on without the addition of any heat, other than that which may be added to the temperature of the room in which the operation is performed, provided it be too cold. It is very important in this operation that the temperature of the interior of the box shall be the same as that of the exterior of it; were it otherwise the plate in passing from the cold to the warm air would be covered with a slight coating of moisture very injurious to the results. In the second place, the oftener the box is used the less time is required, because the wood inside of the box absorbs the vapour of the iodine, and this vapour tending always to disengage itself, and rising from all parts of the interior of the box spreads itself much more equally and quickly over the whole surface of the plate, which is an important advantage. On this account it is a good plan always to leave a little iodine in the capsule which is at the bottom of the box, and to preserve the box from humidity. It is thus evident that the box becomes better the longer it it used, for the operation is thus performed in a shorter time. Since, from the causes just mentioned, the time necessary for obtaining the golden yellow coat cannot be accurately fixed (it may vary from five to thirty minutes, rarely more, unless it be very cold) it may be conceived that it is indispensably necessary to examine the plate from time to time, to see whether it has reached the requisite degree of colour, but it is at the same time important that the light should not strike directly upon it. It sometimes happens that the plate will be more deeply coloured on one side than on the other; in this case, in order to equalize the coating, in replacing the frame upon the box it is turned, not upsidedown, but end for end. The box must be placed in a dark room, into which no light penetrates excepting through the door which is left a little open; and when we wish to examine the plate, after removing the cover of the box, we take the board in both hands, by its ends, and turn it up quickly. It will be enough that the plate reflects a slightly illuminated spot as far off as possible, in order to see whether the yellow tint is sufficiently deep. The plate must then be quickly replaced in the box, if the coating has not attained its proper colour; if, on the contrary, it has gone beyond it, the coating cannot be used, and the first operation must be recommenced from the beginning.

This operation may, in the description, appear difficult, but with a little practice, we are able to judge very nearly the time necessary for the attaining the yellow colour, as also to examine the plate with great quickness so as not to give the light sufficient time to act upon it.

When the plate has attained the proper colour it must be placed in a frame which fits into the camera obscura. The light of day must be prevented from striking upon the plate; for this purpose, therefore, we use a candle, the light of which has much less action; this light must not, however, be suffered to strike too long upon the plate, upon which it will leave marks.

We pass then to the third operation, which is that of the camera obscura. We should pass as quickly as possible from the second operation to the third, or at all events we should not leave more than an hour's interval between them; after this time the compound of iodine and silver has not the same properties.

Observations.—Before using the box it is necessary to clean the interior, and to turn it upside down so as to shake out of it all the small grains of iodine which may have fallen out of the capsule, taking care not to touch the iodine, which would soil the fingers. The capsule should be covered with a piece of gauze stretched upon a ring; this gauze serves to equalize the evaporation of the iodine, and at the same time to prevent the compression of the air, which results from shutting the box, from causing the particles of the iodine to fly about; some of which might rise to the plate and would make deep stains upon it.



On this account the box should always be shut very gently, so as not to cause the rising of any dust within it, which might be charged with the vapour of iodine.

Third Operation. No apparatus is necessary for this operation except the camera obscura, fig. 2. The Third operation is that in which the picture is obtained by means of the camera. Objects illuminated by the sun must be selected, as far as possible, because the operation is under these circumstances much more prompt. It may easily be conceived that as the result is caused by the light alone, the action will be quicker, in proportion as the objects are more strongly illuminated, and are naturally whiter.

After placing the camera obscura opposite to the landscape, or whatever other object, we may desire to copy, the important point is to arrange the focus so that the objects may be defined with great clearness; which is easily done by drawing out, or pushing in, the frame of the ground glass which receives the image. When great precision has been attained, the movable part of the camera obscura is secured by means of the screw adapted for this purpose, and the frame of the glass is then withdrawn, (taking care not to derange the camera) and replaced by the apparatus which contains the plate and which fits exactly into the place of the glass. When this apparatus is properly adjusted, by means of the small copper buttons, the opening of the camera is closed, and the interior doors of the apparatus opened by means of the two semi-circles. The plate is then ready to receive the impression of the view, or object, which has been chosen. Nothing remains but to open the diaphragm of the camera, and count the minutes by the watch.

This operation is one of great delicacy, because nothing is visible, and it is utterly impossible to determine the time necessary to produce the effect, since this depends entirely upon the intensity of the light from the objects which we wish to copy; this time may vary, at Paris, from three to thirty minutes.

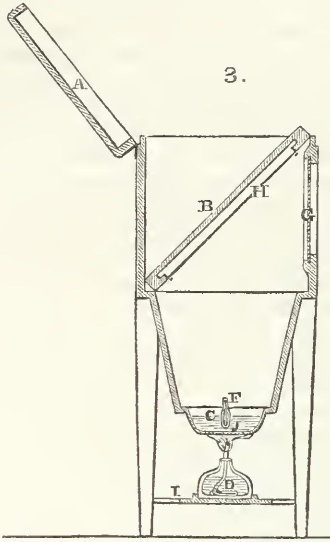
It must be remarked also that the season of the year, as well as the time of the day, exercises a strong influence on the quickness of this operation. The most favourable time is from 7 until 3 o'clock; and, at Paris, what we obtain in three or four minutes in June or July, will require 5 or 6 minutes in May or August, 7 or 8 in April or September, and so on, in the same proportion as we advance in the season. This is, of course, but a general result for objects strongly lighted, since 20 minutes is oftentimes necessary in the most favorable months, when the objects are entirely of a demi-tint. We see, from what has been said, that it is impossible to state with precision the time necessary for obtaining the impressions; but with a little practice, we easily learn to guess at it.—It is evident, that in the south of France, and generally in all countries where the light has a great intensity, as in Spain, Italy, &c. &c., the impressions will be made more quickly. It is also important not to leave the apparatus for a longer time than that necessary for the production of the effect, for the lights will no longer be white, they will be blackened by the prolonged action of the light. If, on the other hand, the time has not been sufficiently great, the impressions will be very vague, and without any detail.

If we have failed in the first impression by withdrawing it too soon, or leaving it too long, we commence another immediately with almost a certainty of success; it is of advantage, even, to make some experimental impressions in order to acquire practice.

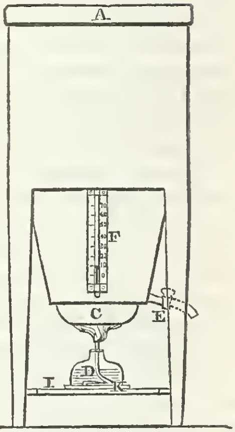
The same remarks are now applicable, as upon the termination of the second operation; we must hasten on to subject the plate to the fourth operation as soon as it leaves the camera. Not more than an hour's interval must be allowed, and we are much more certain of success, when we can proceed immediately.

Fourth Operation.—For this we must have,
A bottle of mercury containing at least 2 lbs.
A spirit lamp.
A glass funnel with a long neck.
The apparatus, figured in fig. 3. 4.

3.



4.



Enough mercury is poured, by means of the funnel, into the capsule placed at the bottom of the apparatus, to cover the bulb of the thermometer. This requires very nearly two pounds. From this time we can use no light except that of a candle. The board upon which the plate is fixed, is withdrawn from the frame, (the cover of which, preserves it from the contact of the light,) and slid into the grooves of the black plate (fig. 3.) This black plate is then replaced in the apparatus upon the brackets, which retain it at an angle of 45°, the metal below, so that it can be seen through the glass; the cover of the apparatus is then gently closed, so as to prevent the concussion of the air from causing the particles of mercury to fly about. When every thing is thus arranged, the spirit-lamp is lit, and placed under the capsule containing the mercury, and there left until the thermometer, (the bulb of which is plunged into the mercury—and the tube passes outside of the box) indicates a heat of 140° Fahr. (60° Cent.); the lamp is then quickly withdrawn; if the thermometer has risen rapidly, it will continue to rise without the assistance of the lamp; but we must be careful not to let it rise above 167° Fahr. (75° Cent.)

The impression of the image exists upon the plate but is not visible; it is not for some minutes that it begins to appear, of which we may assure ourselves by looking through the glass, using the light of a candle, and being careful not to let the light strike upon the plate for too long a time, since it would leave its marks upon it. The plate must be left until the thermometer has again descended to 113° Fahr. (45° Cent.); it is then withdrawn and this operation is terminated. When the objects have been strongly illuminated, and the plate has been left rather too long a time in the camera obscura, this operation may be completed before the thermometer has fallen to 130° Fahr. (55° Cent.); we may observe this by looking through the glass.

It is necessary after each operation, to clean the interior of the box carefully, and remove the thin coating of mercury which forms all over it. The black plate must also be cleaned with care, so that no trace of the mercury may be left upon it. When the apparatus is packed for a journey, the mercury in the capsule must be replaced in the bottle, which is done by inclining the box so that it may run out of the small stop-cock placed for that purpose.

The impression may be examined by a feeble light to see whether it has succeeded. It is detached from the board by removing the four small metallic strips which must be carefully cleaned with pumice and a little water, after each impression. It will be seen that this cleaning is necessary, since, not only are these strips covered with a coating of iodide, but they have also received a part of the impression. The plate is placed in a grooved box until it can be made to undergo the fifth and last operation, which need not be performed immediately, for the impression may be preserved in this state, for several months, without undergoing any alteration, provided it be not often examined in a strong light.

Fifth Operation.—The object of this operation is to remove the coating of iodide, which would otherwise, when the impression had been too long exposed to the light, continue to decompose and destroy the picture.

For this operation we must have,

A saturated solution of common salt, or a weak solution of pure hyposulphite of soda.

An inclined plane or frame.

Two tinned copper pans.

A kettle of distilled water.

To remove the coating of iodide, common salt is introduced into a jar, or wide mouthed bottle, until it is one fourth full, it is then filled with pure water. The bottle is from time to time shaken to assist the solution of the salt. When the water is perfectly saturated, that is, when it can dissolve no more salt, it is filtered through unsized paper so that the solution may be free from dirt, and perfectly limpid. This saturated solution of salt is prepared beforehand in sufficient quantity and kept in well corked bottles; by this means we avoid the trouble of making it, at each experiment. The salt water is poured into one of the basins to within about one inch of its edge: the other is filled with ordinary pure water. These two liquids must be heated, but not to boiling. The solution of common salt may be replaced by a solution of pure hyposulphite of soda, this is even preferable, because it removes the iodide entirely, which the solution of salt will not always do, especially when the impressions have been made for some time. In other points, the operation is the same with either solution; that of the hyposulphite need not be heated, and less is needed, since it will be sufficient that the plate be covered by it, when at the bottom of the pan. The plate is first dipped into the pan containing pure water; it is merely dipped and withdrawn immediately, since it suffices that the surface of the plate be covered with water; then, without suffering it to dry, it is plunged into the salt-water. If the plate be not dipped in the pure water before plunging it into the solution of salt or hyposulphite, these will make ineffaceable stains. To facilitate the action of the saline or hyposulphite solution, which takes up the iodine, the plate is agitated by means of a small hook of tinned copper, which is passed under the plate, which is thus lifted, and suffered to fall again, several times. When the yellow colour has altogether disappeared, the plate is removed, by pressing both hands upon its edges, so that the fingers shall not touch the impression, and plunged immediately into the first pan of pure water.

We then take the inclined frame, and the kettle, which must be very clean, and in which distilled water has been boiled. The plate is taken from the pan of water, and placed at once, upon the inclined plane; then, without giving it time to dry, distilled water, very hot, but not boiling, is poured upon the surface of, and from above, the plate, so that, in descending, the water may form a sheet over its whole surface, and carry with it the whole of the solution of salt or hyposulphite, already much weakened by the immersion of the plate in the first pan.*

At least a quart of distilled water must be used for a plate of ten inches square. After pouring such a quantity of water upon the plate, it is but seldom that one or two drops do not remain upon it. We must then drive them hastily off, before they have time to dry, for they may contain some particles of salt, or, even of iodide; they are removed by blowing strongly with the mouth upon the plate.

It is evidently important, that the water used for washing should be pure; for in drying upon the surface of the plate, notwithstanding the rapidity with which it dries, if this water contained anything in solution it would form numerous and ineffaceable spots.

To test whether the water is fit for this washing, we put a drop upon a burnished plate, and if, when evaporated by means of heat, it leaves no residuum, it may be employed without fear. Distilled water will leave no trace. After the washing, the picture is finished, nothing remains but to preserve it from dust and from vapours which might tarnish the silver. The mercury which causes the image to be visible, is partly decomposed, it adheres to the silver, resists the water poured upon it, but cannot sustain any rubbing.

To preserve the impressions, they must be put under glass and cemented in; they are then unalterable, even in the sun.

As on a journey it may be impossible to attend to the framing of the impressions, they may be equally well preserved in a box with grooves. For greater security, small strips of paper may be pasted over the joints of the cover.†

It must be remarked, that the plates of silver upon copper may be used several times, so long as the copper is not exposed. But it is very important that the mercury should be removed each time, as before explained, by pumice and oil, frequently changing the cotton; otherwise, the mercury will finally adhere to the silver, and the impressions obtained upon this amalgam, are always imperfect, wanting both vigour and cleanness.

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* If the hyposulphite solution be used, the water should be less warm than with the common salt.

† The author endeavoured to preserve the impressions by means of different varnishes, obtained from amber, copal, caoutchouc, wax, and several resins; but, he remarked, that by the application of any varnish whatever, the lights in the picture were considerably lessened, and the strength at the same time reduced. To this inconvenience is joined that of the decomposing the mercurial surface by its combination with the varnishes tried. This effect, which was not developed for two or three months, in the end, destroyed the image entirely.

However, it sufficed to induce the author to reject the use of the varnish entirely, that it destroyed the intensity of the lights; since the most desirable improvement upon the process, would be the means to increase them still more.—Author.

According to M. Arago, M. Dumas has found that the plates may be varnished by pouring upon them a boiling solution of one part of dextrine in five parts of water.—Translator.

Franklin Institute

Sixty-third Quarterly Report of the Managers of the Franklin Institute.

The Board of Managers respectfully present their report for the past quarter.

This quarter, including the summer months, is one of the least active of the year, and its operations are chiefly confined to preparations for the busy season which follows it. The lectures and schools of the Institute have, as usual, occupied much of the attention of the committee having charge of them. The regular lectures on general chemistry, on mechanics and natural philosophy, and on technology, will be again given by Professors Mitchell, Cresson, and Booth, whose services have heretofore been so highly appreciated by the members of the Institute. An arrangement has also been made, by which it is expected that a brief course of lectures on architecture may be added to the regular lectures. The regular course will begin on the fourth of November next. The drawing school will open on the twenty-second instant, with the usual arrangements, as far as the department of miscellaneous drawing is concerned, and under the charge of the former able teacher, Mr. William Mason. It has been deemed advisable, chiefly with a view to prevent interference on the part of our school with that of the Carpenters' Society, to suspend the instruction in the architectural department. It is, however, due to the former teacher, Mr. J. McClure, to state, that previous to coming to this determination, it had been ascertained that his engagements would prevent him from continuing in the charge of the school.

The monthly meetings have been resumed, and the first of the season, which was held on the fourth Thursday of September, was well attended, and supplied with objects of interest. The committee who have charge of the arrangements for their meetings, are active in endeavouring to bring before the members new objects of mechanical or scientific interest.

The committee of science and the arts have, by direction of the managers, reported the number of Scott's legacy premiums awarded under the authority conferred by the City Councils. These are eleven in number, distributed as stated in the report hereto appended. While the committee desire not to hold the premium so high, as not to be attainable by ingenious inventors for whom it was intended by Mr. Scott, they do not feel justified in awarding it without such scrutiny as shall show that the invention for which the award is made, has real merit.

During the past quarter, exhibitions of domestic manufactures have been held at New York, by the Mechanics' Institute, and by the American Institute, and at Boston, by the Massachusetts Charitable Mechanical Association, to all of which delegates have been sent from this Institute. The display of articles at these fairs, has been represented as very creditable to our country, embracing specimens of the useful arts in a high state of perfection. The impression made by these visits, is calculated to stimulate our own exertions in future exhibitions of the same kind.

Additions of twenty-eight volumes, have been made to the library since the last report, besides pamphlets and periodicals. The cabinets of models and minerals have also been increased by donations.

George W. Smith has become a life member, and fifteen new members have been elected during the quarter.

The Board communicate with regret, the decease of two of their former valued members, Matthew Carey and Rufus Tyler. Mr. Carey was one of the first Vice Presidents of the Institution, and took an active interest in its concerns, when every effort was required to place it in its present favourable position before the public. Mr. Tyler was one of the early members of the institution, and served for many years in the Board of Managers, and upon committees of the Institute, with zeal and ability. His name is connected with the prominent undertakings of the institution since its commencement, and as a contributor to the pages of the Journal, his services also deserve mention. Three years since, Mr. Tyler accepted the situation of chief coiner at the Branch Mint of New Orleans, in which city he fell a victim to the prevailing epidemic in September last, bearing a character for fidelity and ability in the discharge of duty, under trying circumstances, the reward of the zeal and skill which he had already displayed in his new vocation. Respectfully submitted.

(Signed) JOHN AGNEW, Chairman.
William Hamilton, Actuary.

COMMITTEE ON SCIENCE AND THE ARTS.

Report of the Committee to the Board of Managers.

The Committee on Science and the Arts, report by direction of the Managers of the Franklin Institute, the number of premiums awarded from the Scott's Legacy Fund, in virtue of the authority delegated to the Franklin Institute, by the City Councils. The following list contains the date of the recommendation of the award, the name of the inventor, and the title of his invention.

1835.	Feb. 12.	Philos B. Tyler, of Philadelphia, for a shifting gauge cock for steam boilers.
	March 12.	Thomas Ewbank, of New York, for tinned lead pipes for conveying water.
	May 14.	McMullin & Hollond, of Sinking Valley, Pa., for a knitting machine.
	"	Amasa Holcomb, of Southwick, Mass., for a mounting for a reflecting telescope.
	Nov. 12.	N. Bassett, of Wilmington, Del., for a compass for detecting local attraction.
	Dec. 10.	W. A. Burt, of Michigan, for an instrument to determine the variation of the compass.
1836.	May 12.	A. Prutzman, of Philadelphia, for a door lock.
1837.	March 9.	Little & Elmer, (formerly of Bridgeton, N. J.,) Philadelphia, for a chronometer.
1838.	Sept. 13.	E. W. Bean, of Philadelphia, for an instrument to determine latitudes.

1839.	April 11.	Thomas Wood, M. D., of Smithfield, Ohio, for a fountain pen, and for an instrument to find the content of irregular areas.
	June 13.	T. Ridgway, Jr., of Pottsville, Pa., for an instrument to be used in geological surveys, &c., called a transit theodolite.

Orders have been drawn for the amount of these premiums with two exceptions, not yet claimed by the competitors.

Various circumstances have prevented, up to this time, the execution of a medal to accompany the premiums. The committee hopes that all difficulties will soon be surmounted, and that medals will be prepared to accompany the orders for the amount of the premium.

The committee has taken every pains to give publicity to the fact, that a fund for the award of premiums to those "who make ingenious inventions," is at their disposal, and to invite competition. While they do not hold the award so high as to be beyond the reach of the ingenuity which it was designed to attest, as well as partially to reward, they cannot without degrading their trust, confer this premium, except for really meritorious inventions; for such as present a reasonable degree of ingenuity, and are likely to be successfully applied in practice. They have even appointed a sub-committee to ascertain if among the articles submitted at the last exhibition of the Franklin Institute, there might not be some which, not coming under the designation of articles on the premium list, might still be worthy of reward. This will probably increase the list now presented, but the committee must observe that the number of premiums awarded must depend upon two circumstances; the first upon the merits, and the second on the number of inventions brought before them. Over the first of these points they can have no control; the second they can only influence by giving publicity to their trust, already done, as far as the Journal of the Franklin Institute and the daily press extend, and by not being so fastidious in their selection of inventions as to prevent competition, which they pledge themselves has been their endeavours in past years, and will continue to be so for the future. The very miscellaneous nature of the premiums awarded, will speak conclusively in regard to this latter point.

On behalf of the committee.

A. D. Bache, Chairman.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Dr. Thomas Wood's Instrument for ascertaining the Area of Irregular Plots.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination an Instrument for ascertaining the area of irregular plots, invented by Thomas Wood, M. D , of Smithfield, Ohio, Report:

That they have examined the instrument invented by Dr. Thomas Wood, and believe it to be novel and ingenious, and very simple in its construction. It consists of two plates of plain ground glass with their inner surfaces fixed in a frame, so as to be parallel to each other, and only so far distant as to permit a piece of drawing paper to slide easily between them. They are of a rectangular form, fastened on three sides in any manner which shall leave the surfaces parallel. The fourth side being open, the space within is partly filled with pure quicksilver. By means of a slip of drawing paper, the outer edge of the quicksilver is made straight and rectangular with the sides. Its position is then marked. This may be done by noting on the paper used, its distance from the outer and open edge of the glasses.

The plot of any irregular plot made from field notes or otherwise, is then moved in till the quicksilver extends to that point of the plot which is nearest the outer and open edge. The outer edge being now parallel to the former edge by the manner in which the paper containing the plot is cut, its distance from its former edge is measured or marked on the same paper, and the area of the irregular field is thus found to be the difference of the areas of two given rectangles.

The committee see no reason why such an instrument should not, when constructed with proper care, give results as accurate as those obtained by the common method of plotting, and dividing into right angled triangles by the dividers and plane scale. The area of the rectangle of any irregular plot, when once completed, may thus be formed in five minutes, and all danger of mistake from errors in the entries or in summing up the partial areas is completely obviated.

The committee consider this very useful and ingenious invention worthy of the Scott's Legacy Premium, and respectfully recommend it for the same.

By order of the Committee.

William Hamilton, Actuary.

March 14, 1839.

Report on Mr. L. E. Denison's Corn Sheller.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Corn Sheller, invented by Mr. L. E. Denison, of Sayville, Middlesex county, Connecticut, Report:

That the peculiarity of this machine consists in the mode of feeding and retaining the ears of corn in contact with the shelling cylinder. The feeding is effected by surrounding the cylinder with a case termed by the inventor, a *revolving concentric cylindrical rest.*

This case is formed of a number of bars or staves, the ends of which are mortised into the peripheries of two circular heads. The staves are placed at sufficient distance apart to admit an ear of corn between them, and the diameter of the case is such that the stave just clears the pins or teeth of the shelling cylinder within it. The cylinder and its case both revolve on a common centre and in the same direction, the cylinder making about ten revolutions to one of the case. Beneath the case is a series of metal bands surrounding about one half its circumference, and pressed against the stave by spiral springs; this is termed the segment concave; it is divided into sections which are independent of each other, so that ears of different size may follow in immediate succession without difficulty.

The ears of corn are placed parallel to the axis of the shelling cylinder in a hopper fixed on one side of the machine. As the cylindrical rest revolves, an ear falls into each space between the staves, and is kept in contact with the shelling cylinder, by the pressure of the segment concave; the grain shelled falls beneath the machine, and the cob is delivered at the side opposite to the hopper, after having been in contact with the cylinder during four or five revolutions.

The arrangement of this machine is different from any that has before fallen under the notice of the committee, and although it may seem somewhat complicated at first view, a farther inspection will show that it is as simple in construction as many other analogous machines. Its operation in the presence of some members of the Institute was highly satisfactory; the cobs were thrown out whole and divested of every grain, and the power requisite to keep it in action was less than in many other machines heretofore in use. As this invention appears to be both new and useful, the committee believe it to be a proper object for an award of the Scott legacy premium, and recommend such award under the usual condition.

By order of the Committee.

William Hamilton, Actuary.

October 10, 1839.

Committee on Premiums and Exhibitions.

The report of the judges on Bookbinders' work and Tools—exhibited at the late exhibition of American Manufactures, held by the Franklin Institute, having been pasted by the judges to the invoice, was, by mistake, filed among the invoices, and consequently overlooked. The attention of the committee having been called to the omission by one of the judges, they with pleasure correct the oversight by publishing the following report.

Com. on Prem. and Exhib.

Report of the Judges on Bookbinders' Work and Tools.

The Committee of Judges on Bookbinders' Work and Tools Report that they have examined the articles exhibited as per list No. 32, and offer the following as the result:

No. 412. A case containing 31 Bibles, and 2 vols. of Switzerland—in consequence of the vols. not being accessible to the Committee for examination, they cannot speak as to the particular merits of the workmanship, but state that they exhibit a very considerable degree of taste and judgment in the design and execution of the finishing, and they doubt not that the workman, by attention and perseverance, will be enabled to produce work of a highly creditable character.

No. 523. A case containing 9 books, among which are a vol. of blank paper bound for the purpose of procuring signatures to the Indian Biography; and a copy of the Waldenses—both of which are done in a most splendid super extra fancy style, displaying a degree of taste in design, and judgment in execution, very rarely combined—also a copy of *Byron,* bound in Morocco super extra with a flexible back, deservedly of a most praiseworthy character, alike in regard to solidity, strength and beauty. There is also in same case vols. of "the Gift," Girls' and Boys' Scrap Books, and a

Bible in 2 vols., which are done in embossed (arabesque) binding; and for beauty of workmanship the committee have never seen them excelled, if equalled. The committee would add in regard to the books exhibited in this case, that it is known to them that they *were not got up* for this or any other public exhibition, but were done in the ordinary business course.

No. 597. A case containing 21 books, one, a copy of "the Gift" for 1839, bound in the most superior splendid super extra fancy calf binding, of the most faultless execution and which, in the view of the committee, cannot be excelled.—Also a copy of Aiken's British Poets, bound in splendid super extra morocco binding; this book also displays the same striking superior excellence. The committee add in regard to the two books in this case, that they certainly display the most superior workmanship of any that have been submitted to their consideration, and congratulate the workman upon his great proficiency, the result of no ordinary talent accompanied by industry and perseverance.

No. 478. A case containing Bookbinders' Dies, Stamps, Scrolls and Rolls. To particularize any one piece of workmanship where all excel, would be worse than useless. These articles deservedly reflect the highest credit upon the manufacturers, and regarding them either separately or as a whole, the committee pronounce them the most superior they have ever seen, unequalled.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN NOVEMBER, 1838,

With Remarks and Exemplifications by the Editor.

1. For making *Sulphate, Carbonate, and other Pigments, of Lead;* Homer Holland, Westfield, Hampden county, Massachusetts, November 3.

This patent is taken for "improvements in the process for compounding, making, and producing pulpy compounds, from metallic lead, and the converting of said pulpy lead into sulphate and carbonate of lead for white pigments; and also for making of said pulpy leads into chromate of lead, known as chromic yellow." The special improvements are said to consist in using any alkaline salt in the *moistening solution*, described in the patent to Mr. Holland, of March 18th, 1836. In employing the pulpy compound produced, as described in said patent, for acetate and nitrate of lead, or with the catalytic additions with neutral chromate of potash or soda, or by dissolving the alkaline chromates in water, and using this chromic solution for the moistening of the charge and chamber.

The claims are in accordance with the foregoing statements; but for the proper understanding of them the two specifications must be before the reader, and we will, at an early day, procure copies of them.

2. For an improved *Atmospheric Soda Water Fountain;* Lansing B. Swan, Rochester, Monroe county, New York, November 3.

An air vessel, or receiver, like the common soda water fountain, is prepared, and placed in a vessel containing ice, to serve as a refrigerator. Into this air vessel is to be forced, by means of a suitable pump, an alkaline solution, made by dissolving an ounce of super-carbonate of soda in every gallon of water. The forcing in of this solution will condense the atmospheric air within the receiver, and cause the solution to flow out when required. Any of the usual varieties of sirop are to be used, with the addition of seven ounces of tartaric acid dissolved in every gallon thereof. About an ounce of this is to be poured into a three-quarter pint tumbler, and the alkaline solution then drawn into it.

The claim is to "the placing of a carbonated alkaline solution in a suitable vessel for containing the same, and causing it to pass, as wanted, into a receiver, or air vessel, by means of a force pump, thereby condensing the atmospheric air contained therein, and thus causing it to operate like the common soda water fountain."

3. For a machine for *Separating Garlic, &c., from Wheat;* Z. Duval, A. Callegan, and J. W. Miller, city of Baltimore, November 3.

The grain is to be rubbed within the space between a solid revolving cylinder, set with teeth, and a hollow cylinder similarly furnished. The main object in view is to effect the rubbing under pressure, and for this purpose the grain is to be fed in through a hopper of considerable height; and the openings for the delivery of it when rubbed, are to be reduced in size and number at pleasure. The grain is led on by placing the teeth spirally. The claim is to "the manner of increasing the pressure upon the grain, by regulating the feeding, and the escape of the same, upon the principle, or in the manner, set forth."

4. For an improved *Curry Comb;* Nathaniel C. Sandford, Meriden, New Haven county, Connecticut, November 3.

This curry comb is made by affixing several wooden combs upon a plate of iron, or upon wood; and the claim is to "the combination of the wooden comb with the other parts so as to make the curry comb, as described."

5. For a *Stopper for Chain Cables;* M. P. Mix, Commander in the U. States Navy, Navy Yard, New York, November 3.

The claim is to "the combination of the slide with the upper plate of the stopper, constructed in the manner described, and operated on by a screw, as herein set forth, so as to stop, or allow a free passage to a chain cable." The machine appears to be well adapted to its object; the chain is to pass between a stationary chock, and a sliding piece, confined between suitable cheeks; the slide is to be operated upon by a strong, three threaded screw, giving full command over the chain cable as it passes through.

6. For an improvement in *Rail-road Carriages, and Wheels;* Robert Grant, city of Baltimore, November 3.

The patentee says that his improvement "consists in the forming a consecutive self regulating train, by connecting the trucks, or frame of the wheels, directly at their centre; whether these frames contain more than one set of wheels or not." The claim is to the particular manner of connecting the train, as described, and "in the improved wheel, the conical form of the inner periphery, in the manner, and for the purpose, set forth." This improved wheel is a modification of that patented by Mr. Granton on the 22d of July, 1837, and noticed under its proper date. As this latter device is not likely to come into use, it is not deemed necessary to make any further remarks concerning it.

7. For *Springs for Rail-road Cars;* Fowler M. Ray, Cattskill, Green county, New York, November 3.

This spring is to be made of leaves or plates, arranged one under the other in the ordinary way, excepting that the ends of the lower plates are not to come into contact with those next above them, until made to do so by the yielding of the spring. The claim is to "the constructing of springs for rail-road cars, or other carriages, in such a manner as that the shorter leaves shall not be in contact with those above them, excepting when the pressure of the load shall cause them so to do."

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8. For an improvement in the *Open Grate for Burning Coal;* James Attwater, New Haven, Connecticut, November 9.

"The design and purpose of this invention and improvement is to inclose the grate, or rack for coal and its contents so as to compel all the air which passes from the room into the chimney to pass through the coal when required, also to prevent the warm air of the room from being carried off too rapidly," &c.

The grate for coal is placed sufficiently far back to admit of transparent sash doors in front, furnished with plates of mica; converting it, in front, into a close stove. The specification is of great length, describing the parts very minutely; the claims, also, are far from brief, but we think that the actual novelty of the thing is not great, and we apprehend that its utility will not be found such as to bring it into general use. There must, unavoidably, be a great loss of heat by inclosing a grate which is set between jambs, as the radiation into the room from the open fire will be much greater, without the interposition of mica doors; and if not set between jambs, such a grate becomes essentially an ordinary close stove.

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9. For an improvement in the *Pump*; Joseph Evans, Lebanon, Ohio, November 9.

In the pump tree there are to be openings in the sides, to get at the bucket, and these openings are to be closed by plugs, and iron bands, which we think a more than questionable *improvement.* The other alterations proposed, stand, in our opinion, in the same predicament; there is sufficient novelty in this invention upon which to found a claim; but, certainly, if we were about to construct a pump, we should have no desire to interfere with the vested rights of the patentee; and as we do not think that we should do him any good by a more full description, or further remarks, we omit them.

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10. For a *Windlass for weighing Anchors;* John M. O'Brian, Brunswick, Cumberland county, Maine, November 9.

This windlass is to be moved by means of handspikes acting upon ratchets and a ratchet wheel at its ends. The ratchet wheel teeth are so formed as to be acted upon by a round bolt, or pin, making a part of the ratchet, the bolt, or pin, being confined between cheeks, to give it the necessary strength. The fulcrum of the ratchet is made capable of being varied so as to increase or diminish the power of the lever, and the consequent motion, at pleasure. These are the main features of the arrangement, and the principal matters claimed. The specification extends through eight well filled pages, and is, we think, unnecessarily prolix.

11. For an improvement in the *Swinging Bridge*; Abner R. Ring, Parma, Monroe county, New York, November 9.

This bridge is to pass over canals, and is to be opened by the contact of the boat, after the passing of which it is to readjust itself. The bridge is to be in two parts, there being a pier in the middle of the canal to support the inner ends of the two sections. These sections turn on pivots on either side of the canal, there being friction rollers, and a circular ring, or hoop, of iron, bearing upon them to sustain the bridge. The boat in passing comes in contact with friction rollers on the ends of levers, which levers give the first impulse in the opening of the bridge. After the passing of the boat, the bridge is to be closed by the action of a volute spring, aided by a counter weight.

Claim.—"What I claim as my invention is the combination of the lever and springs for giving the first impulse to the opening of the bridge; the mode of preventing the jar when the boat comes in contact with the bridge, and guiding the boat through by means of the springs and rollers; and the mode of closing the bridge by means of the combination of the volute spring and counter weight, as described."

The plan appears to be devised with skill, and in a model the operation will be very promising, but beyond this we want for confidence. The structure must, we think, be very light indeed, which could be made to act in the way proposed. If the experiment has been successful, however, we shall be glad to hear of it, and to give it publicity.

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12. For an improved mode of "*Preparing Fuel, and also Stoves to be used therewith;*" Thomas Joyce, Great Britain, November 12.

This invention made much noise for a time, and was considered as a real improvement by several persons eminent for chemical science, but we believe that the plan has been abandoned, and is to be considered as an utter failure. The proposed fuel consisted of charcoal heated with potash; and the stove was to be without a pipe, the products of combustion all escaping into the room. The carbonic acid was to combine with the potash, and thus to prevent all injurious effect from it. We were never able to see how this could be, but if the overwhelming testimony of actual and continued experience had been against us, our theory would have had no weight, and we should have hailed a new fact, and a valuable improvement.

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13. For an improved *Cooking Stove*; Daniel Tisdale, Canton, Norfolk county, Massachusetts, November 12.

In this stove, which is square, there are three ovens, the lower one covers the whole bottom plate, with the exception of room for two side flues. The upper part is divided from front to back into three compartments, the middle one of which is the fire chamber, and those on each side of it are ovens; the draught from the fire passes down to, and entirely under, the lower ovens. There are, as usual, perforations in the top, for cooking utensils. The claim is to "a stove having a large oven covering the whole of the bottom plate with the exception of the flue spaces, in combination with the fire chamber and two side ovens placed above it, and with the respective flues and their appendages conducting the draught in the manner described."

14. For a *Turning Key for Piano Fortes*; John Cutts Smith, Boston, Massachusetts, November 14.

The handle of this turning key stands out horizontally, and the socket which fits on to the turning pins is furnished with a toothed wheel, or wheels, which are received in the head of the handle. A sliding bolt, urged forward by a spiral spring, is contained within the handle, and engages between the teeth of the toothed wheel, a trigger being used to withdraw said bolt. Instead of this arrangement, double ratchet wheels, with palls, or catches, are sometimes used; the object in both cases being to allow the handle to be moved in either direction without its acting upon the socket.

Claim.—"I shall claim as my invention, the above turning keys, constructed and operating in the manner set forth and described; and I also claim the application of a ratchet or toothed wheel, or wheels, to the top of the shank of the key, by which, in connexion with other suitable machinery applied thereto, the handle may be disengaged at pleasure, with the key, for the purpose of operating the same in the manner above described."

15. For a *Double Mould Board Plough;* Stephen Gregory, Sawpitts, Westchester county, New York, November 14.

As is the case in the greater number of improvements in ploughs, the present patent is taken for the peculiar mode of connecting the respective parts, whilst the general construction remains unchanged. The claims are to "The application of a double rebate and cheeks on both sides of the head piece, to receive corresponding parts in the fore end of the mould pieces, by which wider or narrower mould pieces may be used on the same standard or head piece;" and to "the mode of applying the dovetailed cross wedge to secure the movable double winged share, as applicable to effect the intended purposes."

16. For apparatus for *Lifting Ships and other Vessels from the Water;* Thomas Bell, Bell Port, Long Island, New York, November 14.

The platform, or cradle, upon which the vessel is to be raised, is placed within a dock, on each side of which there are "tilting boxes," that are made triangular, and rest upon one of their angles; these boxes are loaded with heavy weights, and are capable of being tilted over from the docks, by means of screws operating upon them, aided by weighted bodies suspended from spars which rise from the boxes like masts. The inner edges of the boxes are connected by rods to the cradle beams.

Claim.—"The manner of constructing, combining, and operating the tilting boxes by the employment of the governing screws, formed and used substantially as set forth; and also, in combination therewith, the weighted bodies suspended from the upper ends of the spars, in the manner, and for the purpose, set forth"

17. For a machine for *Splitting Leather;* Elias Putnam, Danvers, Essex county, Massachusetts, November 20.

This leather splitting machine, is in its general action so much like some others of the many invented for the same purpose, as not to require any particular description. The claim is to "the application of a knife to the interstice between the two rollers, in such a manner that pieces of leather may be propelled against the knife by the revolution and pressure of the rollers, and may be thus pressed and slit at the same time."

18. For a *Mud Machine;* John Hart, Middletown, Middlesex county, Connecticut, November 20.

There are various devices referred to, in the claim by letters and figures, showing by the aid of the drawings, the manner in which the patentee has arranged the lifting chain, and other parts of his machine; but these are not susceptible of clear general description, and the claim alone would not show any thing intelligibly.

19. For a machine for *Hackling Hemp and Flax;* Foster Demasters, Shelbyville, Shelby county, Kentucky, November 20.

The hackles, in this machine, are fixed to an endless chain, their operation not differing essentially from others previously used; the patentee, however, believes that he has so arranged them as to cause them to act more advantageously than in other machines: these arrangements are made known by the drawings, and the claim is to "the combination of the endless chains of hackles with the lips and stationary teeth in the inclined board, for hackling hemp and flax."

20. For a *Cotton Gin;* William P. Baker, Boston, Massachusetts, November 20.

This gin is of the roller kind, for long staple cotton; the rollers are to be of steel, and are to have teeth on them, so that they may gear into each other; one of the rollers, however, it is said, may be of cork, or other soft material. There is a revolving vibrating feeder, and some other appurtenances, the description of which we shall omit; the claims are, to the vibrating feeder with teeth on the same; to a system of stationary teeth between which the revolving teeth pass; to a moving comb; and to a mode of adjusting the bands by means of sliding frames, in combination with the parts to which they are attached.

21. For an improvement in *Piano Fortes;* Edwin Brown, Boston, Massachusetts, November 20.

The object of this invention it is said, "is to effect what is termed the *single string change of the hammers*, without any lateral motion of the hammers, as has usually been the practice heretofore."

"It has been necessary to fit and arrange the hammers very nicely, in order to insure their perfect action when changed from the double to the single string. By my improvement one of the strings of each note is clamped or held, and thus prevented from vibrating when the hammer strikes it; the other being free, will vibrate and produce the sound." The means by which the patentee produces this effect is then pointed out, and the combination of the parts, substantially as described, is claimed; and also the "clamping the strings between cushions, or dampers, situated with regard to each other, and affixed to bars or beams, in the manner described; with the arrangement of the machinery which in connexion with the beams, gives motion to said beams when the pedal is pinned down by the musician."

22. For improvements in the machine for *Shearing Woolen Cloth;*

Seth Parsons, Hoosick Falls, Rensellaer county, New York, November 25.

By means of his improvements, the patentee states, that he "is enabled to shear broad and narrow cloths, the machine operating upon it in its passage back and forth, both ways, without changing it, from end to end." The machine resembles that patented by Mr. Parsons, in March, 1819, but differs from it in the essential particulars above referred to, namely, in its shearing the cloth in its passage back and forth; and also, in a mode of reversing the motion of the brush so as to brush the nap either way as occasion may require, and to raise and lay the nap with the same brush. The claims we need not quote, as they are to the means described in the specification for attaining the foregoing ends.

23. For a machine for *Crimping Leather;* George and Major Alger, Greenport, Columbia county, New York, November 25.

To seize and hold the leather, there are double pincers, between which a screw operates, having upon it a wedge, which, as the screw is turned, is forced between the cross jaws of the pincers, and causes them both to close. The claim is to the cross jaws as operated by the wedge and screw, and combined with them in the manner and for the purpose described.

24. For a machine for *Cutting Straw, Hay, Rags,* &c.; John Boynton, South Coventry, Tolland county, Connecticut, November 25.

There are two revolving cylinders which are geared together by pinions, so as to preserve their relative positions. Knives pass from end to end of each of these cylinders, standing at right angles to them, and so situated as that the knives of one cylinder shall stand in the middle of the spaces between the knives of its fellow, in their revolution, and come as nearly as possible into contact with said cylinders. The straw, &c., to be cut is put into a hopper above the cylinders, and requires no feeding apparatus.

The action of this machine is perfect, cutting the articles placed in the hopper with great rapidity, but still we do not think it destined to continue in use; any hard substance introduced with the articles to be cut, will ruin the knives, and such articles are sure to find their way in.

The claim is to "the method of cutting straw, hay, rags, and other substances, with two sets of knives in two distinct cylinders, which, in the revolution of the cylinders, shall pass by each other, the one coming nearly up to the periphery of the cylinder opposite, in the manner described."

25. For an improvement in the process of *Tanning;* Thomas Chase, City of New York, November 25.

(See Specification.)

26. For an improved *Plough;* John Deats, Roxborough, Warren county, New Jersey, November 25.

The claims under this patent are, mainly, to devices employed in adapting the parts of the plough to each other, and confining them in place; and although these devices may be very good, a detail of them would not furnish any valid information, as reference is made to the specification and drawings for their illustration.

27. For a machine for *Gathering or Pulling Flax and Hemp,* by

animal power; William Britain and John Silvers, New Hope, Hunterdon county, New Jersey, November 25.

The claim under this patent is to "a machine, which, as it is drawn forward, embraces the plants between a revolving drum and bands, by which they are pulled out of the ground and deposited on a suitable platform, as described." The platform which sustains the revolving drum runs upon wheels which bear upon the ground, and the axle of one pair of these wheels is geared, by bevel wheels, to the axis of a drum which revolves horizontally. The plants pass in between this drum and a pointed arm which projects forward; they are there clasped between the drum and bands which extend in part round it, and round guide pulleys, and are thus pulled out of the ground, and carried far enough round the drum to be deposited on the platform, the bands being led off from the drum by the guide pulleys at the required point.

28. For an improvement in the *Organ*; John Meads, city of Albany, New York, November 25.

We are led to expect a particular description of these improvements, from the patentee, with the requisite engravings. The improvements consist mainly, in the substitution of puppet valves for those ordinarily used; a peculiar arrangement of these valves in relation to the wind chest, and the manner in which the key acts upon the stem of the valve; these are said to be real improvements, but they are not of a nature for mere verbal description.

29. For an improved *Lamp for Burning Spirits of Turpentine;* Luther Jones, city of New York, November 25.

Claim.—"The invention claimed consists in placing two flat tubes, communicating with the fountain, or turpentine holder, within the inner circle of the fountain, (that being of the usual conical form,) each tube containing a sliding clamp which embraces and holds the wick moving in said tubes, placed under a round, or oval, glass chimney, the bottom of which being closed by a horizontal plate, except an oblong space through the centre for creating a draught, so formed as to admit the clamps sliding up and down by means of wire handles connected to the clamps, thereby regulating the light in an instant; from that of the feeblest taper, to a large and brilliant flame, producing a most powerful light in every direction, increased by drawing down the wick instead of raising it, as described."

What are called clamps, are two pieces of tin plate which embrace the wick between them, allowing it to project a trifling distance below their edges. The wick is about two inches wide in the lamp which we have seen, and when it is desired to diminish the light, the clamps, and consequently the wicks, are drawn down.

So far as experience may serve as a guide, the lamps for burning spirits of turpentine are not likely to supersede those for burning oil; there are serious objections to the use of the former, and amongst them is the inflammability of this fluid, for although far less dangerous than what has been called the spirit gas, it is yet far from a safe article.

30. For an improved *Lamp;* Joshua S. Beale, Great Britain, November 29.

This lamp is intended for the burning of a variety of articles as a substitute for oil; the patentee mentions "certain fluids obtained by the distillation and occasionally rectification from coal tar, vegetable tar, animal oil, turpentine, rosin, India rubber, bitumen, mineral naphtha, petroleum, and some other of the oleaginous or resinous substances, by mixing with the vapour of the volatile oils obtained from these substances, either atmospheric air alone, or a mixture of air and inflammable gas, such as coal gas and others."

We do not deem it necessary to attempt to describe the construction of this lamp, as we do not think it one that is adapted to the wants of the United States; and will merely observe, therefore, that it has a reservoir and burner similar to those used in the Argand lamp, and that there is, of course, a tube appended to it for the supply of coal, or other, gas, when such is to be introduced in addition to the combustible material contained in the reservoir.

31. For an improvement in the *Manufacture of Iron;* George Crane, Great Britain, November 29.

It is very generally known that Mr. Crane has succeeded, at his works in Wales, in the smelting of iron by means of anthracite, in the ordinary furnace, by the aid of the hot blast. It is for this that the above named patent has been granted in the United States, as, from the similarity of the Welsh stone coal, and that of Pennsylvania, it was anticipated that the same mode of treatment must succeed with us; this, however, must necessarily be determined by the test of experiment, as differences, apparently slight, in the constitution of the two articles might make very decided differences in the result. For some time past, the necessary arrangements have been in progress for the settlement of this question in the most unequivocal manner, and it has recently been announced, that after encountering those difficulties which almost uniformly attend such undertakings in their incipient state, the most perfect success has attended the experiment; should this be the actual fact, and we have no reason to doubt it, we shall obtain, and lay before our readers, all the necessary details respecting the progress and results of the undertaking.

32. For a *Universal Bevel Gear;* John Lewis, Burlington, Chittenden county, Vermont, November 29.

The patentee claims the "Universal Bevel Gear," as the same is described in his specification; a principal illustration of the manner of forming this gear is given in the construction of a drill for dental purposes, in which the point of the drill may be made to act in any desired direction with the main shaft upon which it is fixed.

The principle of action is as follows. Let there be two toothed wheels cut with teeth upon their faces so as to constitute them crown wheels, and let the teeth be continued across their peripheries, so as to constitute them spur wheels also; if they stand with their faces towards each other, and their axes in the same line, their crown teeth will interlock, forming a perfect coupling; and if the two wheels are so fixed in a frame that they may be made to stand at right angles with each other, they will then have their crown teeth engaged so as to operate as bevel gear, as they will also at any intermediate angle, If they are carried still further round, so that they engage as spur wheels, the two axes will be parallel, and if a drill be contained in one shaft, its point will be directed towards the operator who turns the other shaft. The dental drill, which has been deposited in the office as a model, shows the perfection of the plan, and in the details of its arrangements is a good manifestation of the ingenuity of the inventor.

Specification of a patent for a Suspension Bridge. Granted to Stephen H. Long, *Lieutenant Colonel, in the Engineer Corps of the United States, November, 7th,* 1839.

Be it known, that I, Stephen H. Long, of the United States Engineers, have invented a new and useful method of constructing wooden, or frame, bridges; which I shall describe under the name and designation of the suspension bridge, and of which the following is a true and adequate description, viz:

The suspension bridge is composed of two or more truss frames, together with arch braces, lateral braces, flooring, &c., and is distinguished from other bridges heretofore invented, and now in use, by reason of the following actions in the posts, main braces, and counter braces of its truss frames, *to wit:* the posts act by *thrust* instead of *tension*, and the main and counter braces by *tension* instead of *thrust*, as in other bridges. Of course the relative positions occupied by the main and counter braces in the suspension bridge, are completely the reverse of those occupied by them in common bridges, and the modes of attachment between the several parts of the truss frame, are materially different from those of other truss frames, as will be hereinafter explained. In all other respects the suspension bridge is similar to the bridges and parts of bridges heretofore patented by myself.

The truss frames consist of the same nominal parts respectively, of about the same dimensions according to circumstances, as those described, and in part claimed as new, in my specification of a patent for a wooden, or frame, bridge, for which I make application for a patent simultaneously with this application for a brace bridge; excepting that the posts may be narrower and shorter, and the main braces about two feet longer than those applicable in conformity to the specification just referred to; said braces passing through, and protruding five or six inches beyond the strings both above and below.

The length of the posts of the suspension bridge is such as to occupy the distance in the clear between the upper and lower strings; or rather somewhat short of this distance in order to admit a wedge, or a set of counter wedges, between one end of the post and the contiguous string. The posts are all flush, or in the same plane with the outer string-pieces of each truss frame.

The main braces occupy spaces between the central and outer string pieces, extending several inches above the upper, and an equal distance below the lower string, and are suspended by tree nails passing through them, and the string-pieces at the head of the first set of posts, and attached in a similar manner to the lower string-pieces at the foot of the second set of posts. This mode of suspension and attachment is carried on through the half bridge span, beginning at the abutment or pier, and ending at the centre of the span. At the centre of the span, the main braces are halved or locked together, and treenailed as before between the string-pieces. The spaces for the main braces between the central and side string-pieces of the upper string, at the centre of the span, being unoccupied, may receive timbers of the same transverse dimensions as the main braces, which may also be treenailed to the string, and thus afford substantial attachments for the heads of the posts and counter braces that meet at that point.

The counter braces are treenailed at their heads and feet, between the main braces, except at the centre of the bridge span, where they are attached in the manner already explained, and at the abutment or piers where they are accommodated with similar attachments in connexion with the lower strings.

Arch braces may be applied in a manner to act as suspension braces, by erecting a gallows at each pier and abutment of sufficient height and strength for this purpose; but the most appropriate mode of applying these parts is that adopted in connexion with the plan heretofore recognized in my patents.

In further explanation of the suspension bridge, reference is respectfully made to the accompanying drawings; which will illustrate more clearly the manner of constructing the suspension bridge and the arrangement of its parts.

Should it be regarded as an object of importance to give to the main braces of the suspension bridge an equable action in all the panels of a bridge, the following rules should be observed and the object in view will be approximately accomplished. Let the extent of the bridge span, between the abutment or pier supports, be 120 feet, and the height of the truss frame, or rather the distance from centre to centre of the strings, be fifteen feet. Now, commencing at either extremity of the span, the first panel should have a distance measured on the strings, from centre to centre of the posts, equal to 5¼ feet, the second panel, a distance of 6¼ feet, the third equal to 7¾ feet, the fourth, 9¾ feet, the fifth, 13 feet, and the sixth, 18 feet, making the aggregate extent of the half span, equal to 60 feet. By this arrangement all the main braces respectively will be subjected to an action nearly equable, and their greatest possible efficiency may be rendered available. The diagrams, hereinafter referred to, will serve to illustrate this arrangement, and guide the builder.

This method of adjustment, by means of which a uniformity of action may be given to all the main braces of a truss-frame, respectively, is also claimed as new and original, not only with respect to the construction of wooden bridges, but also with respect to bridges composed of iron, or partly of iron and partly of wood; which may be constructed of similar parts nominally, though these parts may all differ in shape, dimensions, and manner of attachment to each other, all of which may be varied according to circumstances.

In the accompanying drawings, plate III, fig. 1, A, B, C, D, exhibits a side view of a portion of a truss frame of my suspension bridge, attached to its abutment; and fig. 2, shows a similar side view of a part of the truss frame, on an enlarged scale, for the purposes of exhibiting its construction the more clearly. C, D, is the arch brace, which bears upon the abutment as shown at C, fig. 1; *n*, *n*, *n*, in the same figure, represent gibs and keys, which pass through and firmly connect the respective thicknesses of timber, of which the arch brace connects below the lower string piece. The space between the two thicknesses of timber of which the arch brace consists, is filled in with what may be denominated a splicing piece, the whole being confined together by bolts, gibs and keys, or treenails.

G, G, are the posts which extend vertically, and have their ends bearing against the lower and upper string-pieces, against which they abut. At *d*, *d*, between the upper ends of these posts and the upper string-pieces, there are counter wedges, which when driven in, necessarily cause these posts to act upon the string-pieces by direct thrust, which causes the main and counter braces to act by tension instead of thrust.

The string-pieces consist each of three thicknesses of stuff, as shown in the top view H, fig. 3, plate IV, and the main suspensor braces E, E, fig. 2, occupy the spaces between the central and outer string pieces, as above stated, and extend several inches above the upper, and below the lower string-pieces; the five thicknesses composing the braces and string-pieces being secured together by treenails passing through them. The first of these braces extends from the head of the first set, to the floor of the second set of posts, and so on to the centre of the bridge, where their direction is reversed. The counter extension braces are shown at F, F, fig. 2, plate III. These consist each of a single piece of stuff, which passes obliquely between the two which constitute the main braces, abutting against the middle timber of the string-pieces, and confined at each of their ends between the main braces and posts, by means of treenails, or other analogous devices.

Fig. 3, plate IV, exhibits a horizontal and vertical section of a portion of one of the strings, and shows the manner of connecting the posts, main, and counter braces with the strings. The shades in the upper part H, of this figure, indicate sections of the posts, main, and counter braces at the upper edge of the lower string, and, by inversion, at the lower edge of the upper string. E, F, and G, designate the same parts as in fig. 2.

In fig. 1, plate V, A, B, C, D, is a vertical diagram, intended to exhibit the relative dimensions of the panels of a truss frame for my suspension bridge, so graduated as that the stress, or action upon the main suspensor braces, may be respectively equal in every part of the frame. *a*, *a*, are the posts, *b*, *b*, the main suspensor braces, and *c*, *c*, the counter suspensor braces. P, P, are the abutments or piers of the bridge. Fig. 2, shows the manner of applying the lateral braces, in order to afford a corresponding action laterally between the string pieces, *a*, *a*, *a*, *a*; it will be seen from an inspection of the figures, that the extent of the panels as measured on the strings, increases as measured from the extremities towards the centre of the span of the bridge.

The straining or trussing of the truss frames is effected by driving the counter wedges above mentioned, which are situated, as shown in the drawing, between the upper end of each post, and the upper string piece, but which may, if preferred, be situated between the lower ends of said posts, and the lower string-pieces.

This operation is calculated to elevate the upper string at the points where the main braces are attached to it, and of course to increase the tension of the main braces of the adjacent panel. Every movement of tension thus produced is counteracted by a corresponding degree of antagonal tension in the counter braces, thence the main and counter braces act by tension instead of thrust, and the posts by thrust instead of tension.

Having thus fully described the manner in which I construct my suspension bridge, I do hereby declare that what I claim as new therein, and desire to secure by letters patent, is the manner in which I have combined the posts, the main braces, and the counter braces, as herein set forth, so that by wedging up the posts between the upper and lower string-pieces by wedges, or counter wedges, the thrust of the posts shall cause the main and counter braces to operate by tension, and thereby to sustain the bridge; the main braces, the counter braces, and the posts being connected with each other, and with the string-pieces in the manner described.

I will here remark that although I have mentioned the strings of my bridge as each composed of three pieces, this number may be increased, if desired; the number of pieces of timber in the respective braces, &c., being made to correspond therewith, STEPHEN H. LONG.

Specification of a patent for an Improved Bridge, denominated a Brace Bridge: granted to Stephen H. Long, *Lieutenant Colonel, in the Engineer Corps of the United States, November 7th,* 1839.

Be it known, that I, Stephen H. Long, of the United States Engineers, have invented certain Improvements in the construction of wooden or frame bridges, the objects of which are greater simplicity, economy and efficiency in the mode of bridge building, and in the arrangement of the parts of bridges, than have hitherto been attained by any combination of principles, or arrangement of parts heretofore adopted in structures of this nature.

The several parts of the bridge to which said improvements relate, are the strings and their splices, the posts, the main braces, the counter braces, and the arch braces of a truss-frame; and also the manner of trussing or straining the truss-frames.

The several parts above enumerated have the same relation to the bridge, and are intended to impart a similar efficiency in sustaining it, as those designated by the same names in the several patents obtained by me for wooden, or frame bridges, and to which reference may be had. These parts however, in the structure herein described, vary materially in their relative, and especially in the transverse, dimensions of the timber used from those contemplated and described in the patents above cited. Instead of timbers of various sizes, and of nearly a square form, the several parts alluded to are to be uniform, or nearly so in all their transverse dimensions, a tranverse section of each timber of all the parts having the form of a parallelogram, varying from two to four inches, by eight to twelve or fifteen inches, according to the length of the bridge-span, the weight of the load to be sustained upon the bridge, and other circumstances connected with these considerations.

Instead of notches or recesses in the string-pieces and posts, by means of which these parts are locked together, and instead of wedges at the insertions of the posts between the string-pieces, the connexions between the posts and strings are effected by means of gibs and keys passing entirely through the strings transversely thereof, and at the same time resting in notches, prepared for the reception of the gib and key, in the back of the post, or in the side opposite to the points or steps at which the main braces communicate their thrust against the posts; the notches serving to regulate and maintain the relations with respect to distance, between the upper and lower strings, the gibs serving to clamp the string-pieces together; and the keys serving not only to confine the strings to the posts; but also, to impart the requisite trussing to the truss frame, and at the same time to force the counter braces into appropriate action.

Joggles, or pieces of timber about two feet long, three inches thick, and three or four inches wide, are inserted in the spaces between the string pieces, and immediately behind the posts, for the purpose of aiding the gibs and keys in counteracting the thrust of the main braces. The joggles are applied subsequently to the adjustments effected by trussing, being confined at one end by appropriate notches in the posts for their reception, and at the other by treenails passing through them and the string-pieces.

The main braces are connected to the posts by means of notches or steps in the latter, adapted to the reception of tuscums at the ends of the former.

Instead of tuscums and steps as described in the preceding paragraph, steps of cast-iron, with appropriate lugs or braces on opposite sides of each step, adapted to suitable receptacles for the same in the posts and braces, as represented in the accompanying drawings, may be substituted for the purpose of receiving and resisting the action to which these parts are subjected.

The counter braces occupy the entire distance between the upper and lower strings diagonally of each panel of the truss frame, and are confined between the posts by treenails passing through them and the posts near the strings. They may also be confined to the main braces by treenails passing through them at the intersections of the former with the latter. The counter braces are brought into their appropriate action by straining upon the gibs and keys of the strings, in the manner before explained.

The arch braces rise in three or more pieces from a bench or bolster attached to the abutment or pier, below the bridge; pass through the lower string in two or more pieces within the openings or interstices occasioned by the posts and main braces; enter the first, second, or third panel of the truss frame, counting from each end of the bridge span, and thrust against the furthermost posts of the panel entered; being intercepted by these posts, against which the thrust of the arch braces is communicated in part by means of appropriate notches in the former, and corresponding tuscums in the latter. The action of the arch brace is continued past the posts by similar pieces and connexions within the next panel, and by the aid of a splicing piece situated between the posts, and extending from the counter brace of the panel first entered, to that of the panel beyond, and occupying the space between the side pieces of the arch brace. Thus continued, the arch brace extends to the head of the next main braces, and is connected with them near the upper string by means of corresponding tuscums and notches. In order to render the action of the arch brace more certain and efficient, another splicing piece is inserted, extending from the counter brace last mentioned to the head of the next counter brace, and occupying as before, the space between the cheeks or side pieces of the arch brace. The several parts of the arch brace situated within the truss frame, as also the posts and main braces at the crossings or intersections of the arch braces, are firmly united by treenails passing entirely through the several pieces of which they are composed.

The interior portions of the arch braces, situated beneath the truss frames, are respectively furnished with a series of gibs and keys, which serve not only to confine together the pieces of which they are composed, but also to render the arch braces extensible, or the reverse, as may be found necessary, either to give appropriate action to the arch brace, or to increase or diminish the camber of the bridge.

The splicings of the outside string pieces, are effected by means of wooden splicing pieces with appropriate notches, and corresponding tuscums, or with joggles of iron or wood, situated in appropriate notches prepared for their reception in the splicing piece and string-piece, and may be clamped together by gibs and keys, or by screw bolts passing entirely through the strings. The central string piece may also be spliced in a similar manner, or by means of treenails of wood passing entirely through the strings, no other clampings being required in this case.

The lateral bracing is effected by means of locked lattice work, banded by ribbands on both sides of each truss frame of the bridge, both above and below the lateral braces. The ribbands are confined to the lateral braces by treenails passing entirely through them and the braces, at every intersection of the former with the latter.

The accompanying drawings will serve to illustrate and make known the manner in which I construct the respective parts of my brace bridge, and carry my improvements into operation.

In fig. 1, plate II, A, B, C, D, represents a side view of part of a truss frame; C, D, being the arch brace with its lower end, C, resting on a bench, or bolster on the abutment or pier below the bridge; *n*, *n*, *n*, showing the situation of the gibs and keys, by which the respective thicknesses of timber of which the arch pier consists, are confined together.

In fig. 2, A, B, C, D, is an enlarged view of a part of such a frame, drawn to a scale sufficiently large to exhibit the mode of connecting the respective parts thereof, C, D, is the arch brace, E, E, are the main braces, F, F, the counter braces, and G, G, the posts. The timbers constituting the arch brace are connected at *g*, *g*, with the posts G, by means of tuscums and notches, and with one of the main braces E, by similar means, as shown at *e*. The main braces E, E, are likewise connected with the posts G, G, both above and below, by like means. The posts G, G, extend a few inches above the upper and below the lower strings. These strings consist each of three thicknesses of stuff, as shown at H, fig. 1, plate IV. The posts G, G, and the main braces E, E, are each of them double, and their ends are received into the spaces between the centre and the two outer string pieces. The counter braces F, F, are single, and abut against the centre string pieces both above and below. They are treenailed at each end to the posts G, G, and also to the main braces where they pass between them.

The space between the two piers of timber which constitute the arch brace C, D, I usually fill up by inserting what I denominate splicing timber, and connect the whole together by passing treenails through them.

It has been mentioned above, that *n*, *n*, *n*, in fig. 1, plate II, show the situation of the gibs and keys, by which the respective timbers composing the arch beam are connected together; such gibs and keys are also employed for the same purpose in various other parts of the structure. Thus, for example, they are employed in the mortises through the timbers shown at *c*, *c*, *c*, *c*, fig. 2. The manner of constructing these gibs and keys, and of inserting and fixing them, so as to confine the timbers together, will be manifest upon reference to fig. 5, plate IV, where they are represented on an enlarged scale. They are also shown as passing through the string-pieces in fig. 1, and through the arch braces in fig. 2. Between the string-pieces, and immediately behind, and in contact with the posts, I insert joggles, or blocks of timber represented by *b*, *b*, *b*, fig. 2, plate II, which I fasten in place by treenails. These are for the purpose of sustaining the posts, and preventing their yielding or splitting at the gib notches. The mortises *c*, *c*, *c*, shown on the upper and lower string-pieces in fig. 2, intersect the posts in those parts, and the posts are necessarily notched out to allow the gibs and keys to pass on their sides opposite to the main braces. These notches in the posts serve, as above remarked, to maintain the relative distance between the upper and lower string-pieces; to clamp and confine them together, and to impart the requisite power of trussing to the truss frame.

Fig. 1, plate IV, exhibits different views of a portion of the string-pieces, showing the manner of splicing them, and also the relative positions of the string-pieces, posts, and braces, as they project into, and are connected with, each other. These representations apply equally to the upper and lower portions of the truss frame.

Fig. 2, represents a portion of the arch brace, with the manner of applying the gibs and keys thereto, by which it may be extended or contracted at pleasure, the several mortises for the gibs and keys being at equal distances from each other. By this arrangement, the camber of the truss frames may be increased or diminished as may be required. The centre and the two outer pieces of the five thicknesses represented as clamped together in fig. 4, are those which rest upon the bench or bolster of the abutment or pier, the other two pieces are those which pass up into the truss frame.

Instead of the notches and tuscums formed in the timber for connecting the main braces and the posts, I sometimes employ steps or bearings of cast iron, which are furnished with lugs or tuscums, projecting out from each of their sides, and entering corresponding notches made in the posts and braces. These are shown in place at *a*, *a*, fig. 2, plate II, and separately on an enlarged scale at fig. 4, plate V; similar steps or pieces of cast iron may be employed for splicing and uniting the string-pieces, being substituted for the intermediate notched splicing-pieces of wood represented as used at II, II, fig. 1.

Having thus fully described the manner in which I construct my brace bridge, and connect the respective parts thereof together, what I claim as new therein, and desire to secure by letters patent, are the following, that is to say:

1st. I claim the forming of the truss frames of bridges by connecting and combining string-pieces, posts, main and counter braces, and arch braces, by the aid of gibs and keys constructed as set forth, using therewith such bolts or treenails as I may deem proper, but not intending to claim the use of bolts and treenails as making any part of my invention.

2nd. I claim the employment or use of the gibs and keys formed in the manner set forth, and passing through the string-pieces, and into the posts near their ends, for the purpose of trussing and straining the frame generally.

3rd. I claim the manner of arranging the arch braces, so as to diminish or increase the camber of the truss frames, by the employment of the gibs and keys passing through those portions thereof, which constitute the lower parts of said arch braces.

4th. I claim the construction and employment of a bearing or step of cast iron, furnished with lugs or tuscums, which are let into corresponding notches in the head and foot of the main braces, and the posts, in the manner, and for the purpose set forth. STEPHEN H. LONG.

Remarks by the Patentee on the Application and Use of the principles embraced in the foregoing Patents.

In the application of the principles contemplated in the preceding patents, and for the purpose of effecting approximately, and with convenience, an equality of action in the main braces of the truss frame, both in the common and suspension bridges, it is deemed advisable to vary the lengths of the panels as measured horizontally on the strings, in the following manner, viz: Let the exterior panel of each bridge span, or the panels nearest the abutments or piers, have respectively an extent of about five feet. Let the panels next in succession, as we proceed from the extremities towards the centre of the span, have respectively an extent of about six feet. Let the third panel from each pier or abutment have an extent of about seven and a half feet; and the fourth, an extent of about nine and a half feet; and let the residue of the panels have a uniform extent of about twelve feet, equal to, or somewhat less than, the distance in the clear between the upper and lower strings of the bridge.

Whenever treenails are inserted, care should be taken to place them in such positions, as will ensure their greatest possible efficiency without impairing the requisite strength and tenacity of the timbers through which they pass.

The treenails should be made of well seasoned, strong and durable timber, and may be formed by driving them through a circular cutter of tempered steel, and of such dimensions as may be deemed most suitable for the particular purposes for which they are intended. The size of the treenails should vary from 1¼ inch to 1¾ inch in diameter. The more numerous the treenails, the more efficient the structure, provided they are not so frequent as to impair the requisite efficiency of the other bridge timbers.

In the use of the improvements provided for in these patents, it should be borne in mind, that a truss frame may be composed of an indefinite number of string-pieces, posts, main and centre braces, as also of arch-brace timbers, all of which may be uniform in their transverse dimensions and of any size that may be deemed most appropriate, from a thickness of one inch and a width of six inches, to a thickness of four to six inches, and a width of twelve to fifteen inches.

The most convenient method of adjusting the splices of the strings, will probably consist in the insertion of splicing pieces of timber between the string-pieces, through all of which gibs and keys, together with treenails (should the latter be deemed appropriate) may pass, confining the whole firmly together. The requisite tension in the strings at the splices, may be provided for by means of iron joggles, passing vertically in notches prepared in the splicing pieces and string-pieces for their reception. The transverse dimensions of the joggles should be about ¾ by 1½ inch, and their length equal to the width of the string pieces. Of course, the notches for the reception of the joggles will be ¾ inch deep, and of an equal width; the notches in the splicing pieces, and in the string-pieces being respectively equal, and correspondent to one another.

In the mode of bridge building herein contemplated, there will be very little occasion for screw bolts or other iron work, yet in the confining of the lateral bracing to the truss frames, and in various other parts of the work, screw-bolts, key-bolts, spikes, &c., will greatly facilitate the structure, and may be employed to advantage.

Inasmuch as no gibs and keys are required at or near the centre posts of each span, screw-bolts or key-bolts will be of service for the purpose of clamping together the strings at these points.

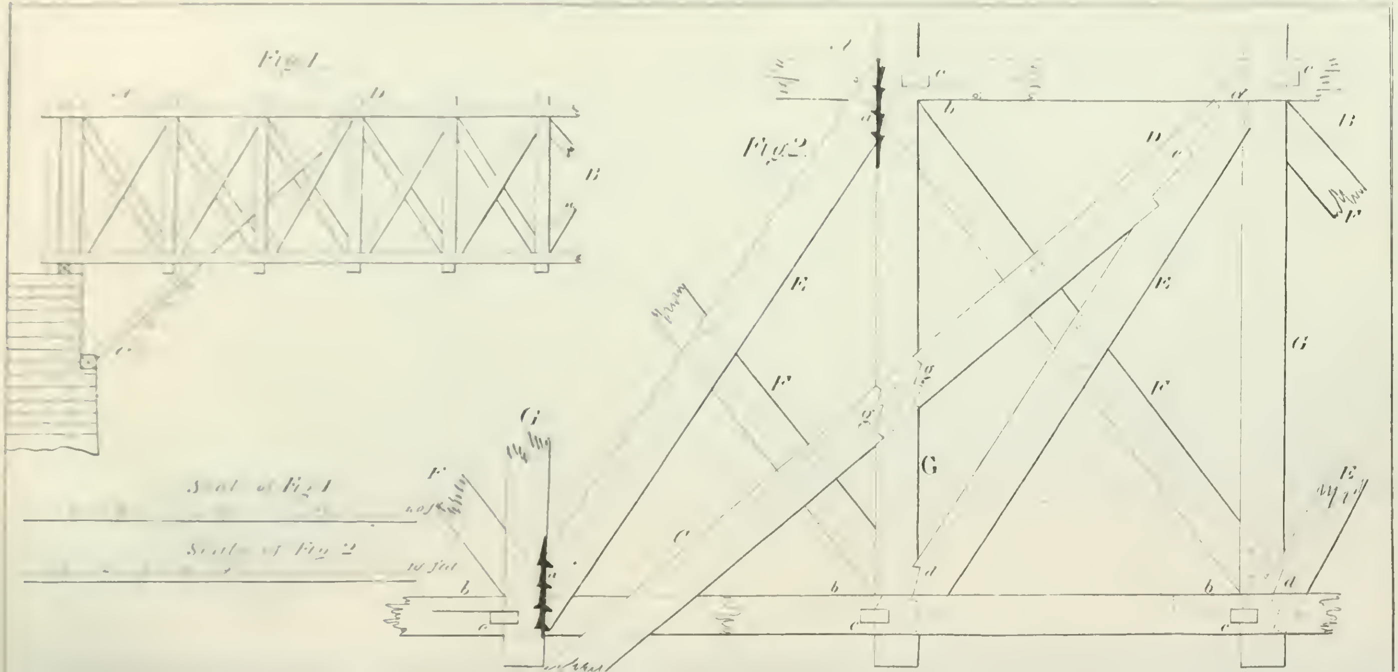
The transverse and stay braces may be applied in the same way as proposed in my former patents.

The adjustments of the arch braces should be such as to insure the greatest possible strength and efficiency. Special care should be taken to introduce the splicing pieces connected with these parts, in a manner to render their action uniformly efficient, quite from the bolster at their lower extremities, to their connexion with the upper strings.

It is obvious that the arrangements prescribed in reference to the suspension bridge, are not only applicable in wooden structures, but, with slight alterations and appropriate modifications, the same principles are equally applicable in the construction of iron bridges. In this application of the principles, it would be advisable to construct all the parts that are exposed to *tension*, of wrought iron, while those exposed to *thrust*, or compression, may be constructed either of wood or of cast iron. The connexion between the strings, main and counter braces, may be effected by means of key-bolts of suitable size, passing entirely through these parts, and confining them togeth-

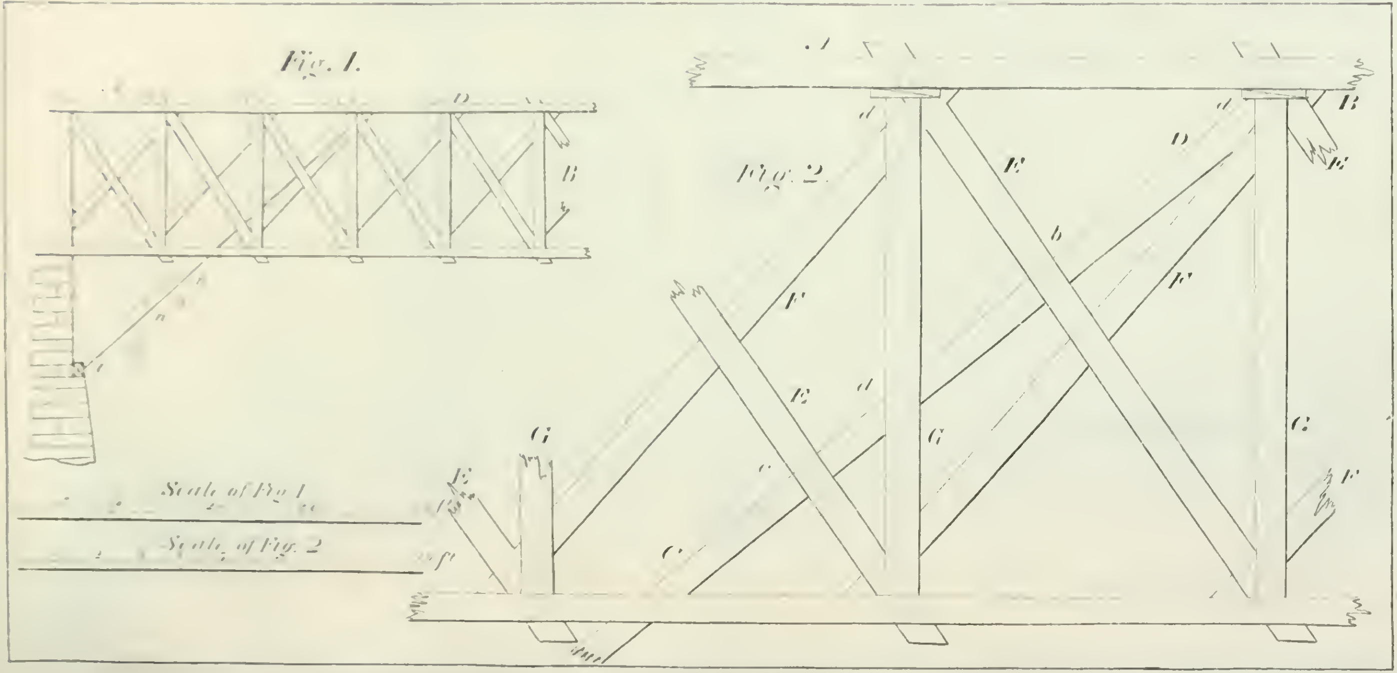
COL. LONG'S BRIDGE.

PLATE II



COLLONG'S SUSPENSION BRIDGE.

PLATE III



COL. LONG'S BRIDGE. PLATE IV.

Parts of Bridge.

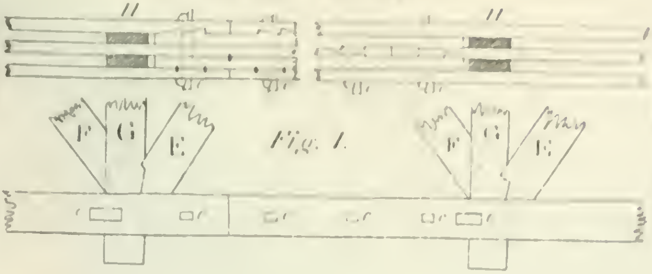


Fig. 1.

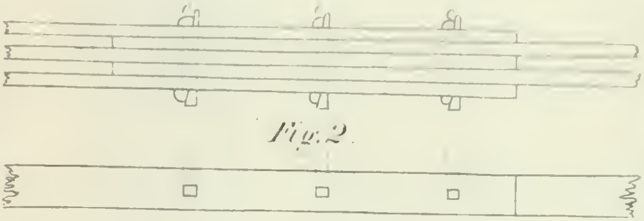


Fig. 2.

Parts of Suspension Bridge

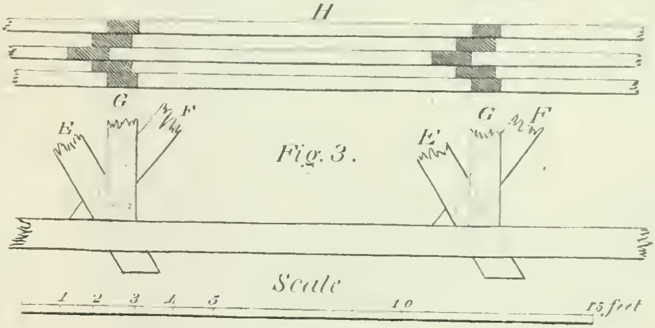


Fig. 3.

Fig. 4.

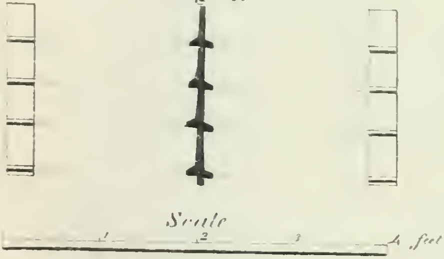
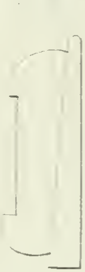


Fig. 5.



COL. LONG'S SUSPENSION BRIDGE

PLATE V

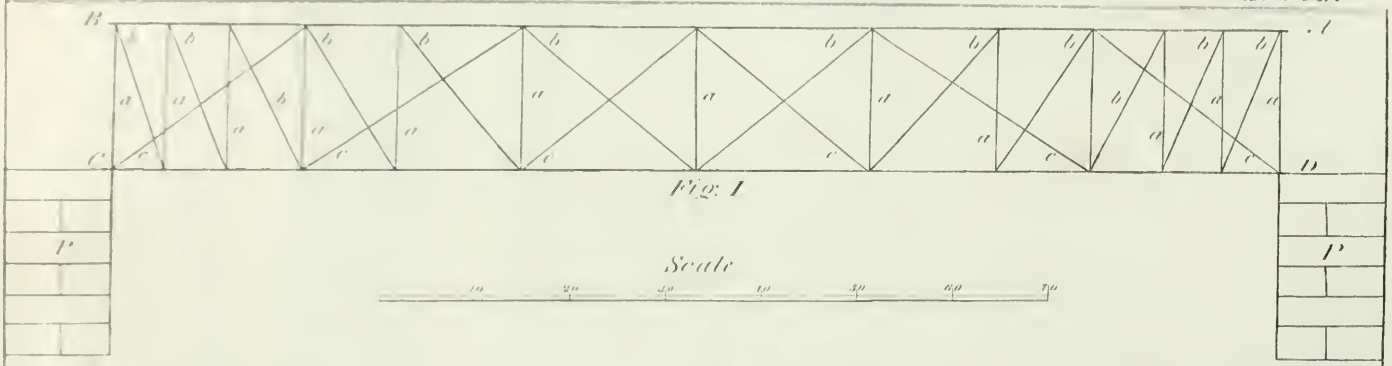
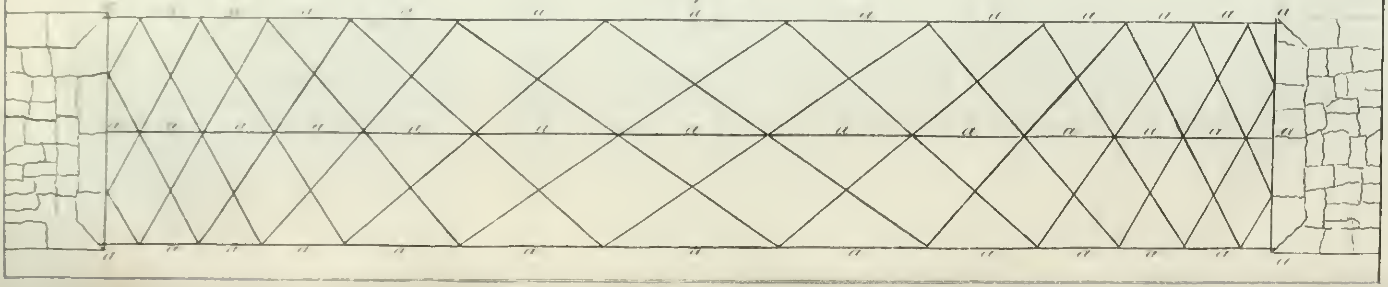


Fig. 1

Fig. 2.



er, the main and counter braces being merely rods or bars of wrought iron with eyes at their extremities, adapted to the reception of the bolts.

It should be farther observed in reference to the suspension bridge, that the heads of the posts should not be confined to the braces till the keys shall have been driven, and the truss frames subjected to their appropriate strain, after which treenails or spikes, at the discretion of the architect, may be inserted through the heads of the posts and braces, and wherever else they may be deemed useful. STEPHEN H. LONG.

P. S. It will be advisable to adopt the following rule for the adjustment of the panels of a bridge span; for example, let the panels situated between any abutment or pier, and the heads of the arch braces, have respectively an extent measured on the strings, about equal to two thirds of the height of the truss-frames from centre to centre of the strings, and let the other panels of the span be adjusted in conformity to the directions prescribed in a former part of this essay. S. H. L.

Specification of a patent for an improvement in the process of Tanning. Granted to THOMAS CHASE, *city of New York, November 25th,* 1838.

To all whom it may concern: Be it known, that I, Thomas Chase, of the city of New York, have invented an improvement in the process of tanning hides and skins, for which process, letters patent of the United States were granted to George H. Richards, of the said city, dated the nineteenth day of December, 1838, by which improvement the process is much simplified, room is economized, and the effect is more certain and rapid, and I do hereby declare that the following is a full and exact description thereof.

Instead of employing two vats, as in the process described by the said George H. Richards, I perform the whole operation in one single air tight vat, which I use in the following manner. I make an air tight vat cistern, or case, of sufficient strength to sustain the pressure of the atmosphere when the air is exhausted therefrom; within this vat or cistern I suspend or lay the hides or skins, in any convenient manner, and completely cover the same with the tanning liquor. The top of the cistern is secured to the body of the vat or box by means of screws, or otherwise, with the intervention of leather or other suitable substance to render the same air tight. By means of an air pump, or other apparatus, affixed on or near the top of the cistern, I exhaust the air therefrom as completely as possible, and after this I work the air pump from time to time, as air will continue to be exhausted from the liquid, and from the pores of the skins, in consequence of the removal of the pressure of the atmosphere from the surface of the liquid. The expansion of the air in, and its extraction from, the pores of the skin opens them, and gives a ready admission to the liquor, or ooze, which in consequence penetrates to the interior of the skin, pervading its whole mass, and tanning it perfectly throughout. I sometimes, after having continued this state of exhaustion for some hours, admit the atmospheric air into the vat, so as to exert its pressure upon the surface of the liquid, allowing it to do so for a short period of time, that it may aid in forcing the liquid into the exhausted pores, after which I again work the air pump and remove the pressure. As occasion may require I renew the liquor in the vat by withdrawing it by a pump, or other means, and returning it to the reservoir of bark or other tanning substance, from which reservoir it is again freshly supplied by a tube, or other means, to the tanning vat. I also have a barometer, or gauge, connected with the vat, by which to ascertain the degree of atmospheric pressure.

After the tanning liquor has completely penetrated the hides or skins, and become incorporated with them, extra atmospheric or hydraulic pressure, (the latter of which I think the most convenient,) may be applied, in order to give the hides or skins an additional solidity or firmness. I do not prescribe any particular mode of constructing the vats or cisterns, there not being any thing peculiar in these, or in any other part of the apparatus, the whole being such as any competent workman can construct without special directions from me; such apparatus having been before known and used for various purposes, and not being of my invention.

What I claim as constituting my improvement, is the application of the principles of exhaustion to tan vats, after the skins or hides have been laid therein, and they have been covered with the tanning liquor in the manner and for the purpose herein fully set forth. THOMAS CHASE.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the Strength and other Properties of Cast Iron obtained from the Hot and Cold Blast. By WILLIAM FAIRBAIRN, Esq.

The collecting of material for ascertaining the comparative values of iron, made from the hot and cold blast, has been a work of no small labour and expense. The chief difficulties arose from the greater part of the works in this country having only one sort of iron: large quantities of both sorts were obtained; but, excepting those irons experimented upon, none could be found for comparison, nor any on which we could depend for analogous results.

Nearly the whole of the Scotch irons are now prepared by the hot blast; and, with few exceptions, we may consider those of this country and Wales produced under circumstances precisely similar. The great saving effected in the process of smelting by heated air, is in itself a sufficient inducement for its extended application; and in those districts where the iron is not deteriorated, there cannot exist a doubt as to the advantages derivable from its introduction. In confirmation of this opinion, it may be important to know, that one-half or three-fourths of the British ores are now reduced by heated air. In the Staffordshire and Shropshire districts it has become almost universal; and in North and South Wales the old process is rapidly giving way to the more economical application of hot blast. In Yorkshire it has been tried with indifferent success, first at the Low Moor Iron Works, near Bradford, and more recently at the Milton Works, near Sheffield. The proprietors of the former establishment persevered for some time in the use of the hot blast, but after repeated trials and experiments (part of which are briefly detailed in this Report), they abandoned the process, as injurious to the material, and reconstructed the old apparatus for the cold blast.

I believe at the present moment they use air at the temperature of the atmosphere: it is forced from the blowing cylinder into a dry receiver, and from thence into the furnace. Whether the failure which took place at the Low Moor was owing to some peculiarity in the ores, or from the presence of sulphur in the fuel, I am unable to determine. It is, however, obvious, that a considerable deterioration of strength was the consequence; and from that cause, and that alone, I am informed, the hot blast was discontinued.

At the Milton Works, the heated air is still in use; and although the iron produced is inferior in strength to that made at the neighbouring works, the Elsicar, where the cold blast is used, it is nevertheless much improved by the introduction of a small proportion of the Ulverstone ores, about six per cent., in combination with those found in the district.

Notwithstanding the unfavourable circumstances attending the application of the hot blast in the reduction of the Yorkshire ores, the same results were not obtained in its application to the Scotch iron. In those a deterioration takes place less frequently, as will be seen from the experiments.

Taking a general mean of the experiments in both cases, the difference is not considerable; and, with the exception of the Yorkshire irons, I should consider the results in no way unfavourable to the hot blast: as respects fluidity, appearance, &c., I should rather deem them favourable than otherwise.

Previous to commencing the experiments, it was considered desirable to collect as large an assortment of iron of both kinds as possible; and in order to avoid an improper selection, direct application was made to the iron masters in the first instance, and subsequently the numerous samples were received through the medium of persons whose interests were in no way identified with this inquiry.

In this way we kept clear of preconceived opinions, and collected a mass of material of almost every description. Out of nearly one hundred specimens, only six could be found answering the description of hot and cold blast; viz. the Carron, Devon, Buffery, Coed-Talon, and perhaps the Elsicar and Milton.*

The difficulties thus enumerated, and the scarcity of the comparative metals, have of necessity confined our investigations to the above-named irons, they are consequently more limited than we could wish; but, at the same time, of such a nature as, I trust, will lead to important results.

As an account of the greater portion of the irons collected could not be introduced into these Reports, I was nevertheless induced to examine them minutely; and having tested the whole by careful experiment, the results will be found in a distinct form in the sixth volume of the Manchester Memoirs, now in the press.

After the request of the Association, expressed to Mr. Hodgkinson and myself, that an inquiry should be instituted into the comparative merits of iron made from hot and cold blast, nearly ten months elapsed before the necessary materials could be obtained. In fact, the experiments would have been of the most meagre description, for want of samples, but for the friendly co-operation and assistance of Mr. Murray, of the Monkland Iron Works. To that gentleman we are indebted for the whole of the Scotch irons, exclusive of valuable information relative to the fuel and analysis of the ores; I have therefore great pleasure in thus publicly expressing my acknowledgments.

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* Since the above was written, it was deemed expedient to renew the application to the Carron Company for further supplies of their iron, in order to investigate its nature with increased attention, in addition to the experiments of last year. Mr. Hodgkinson expressed a wish to renew his experiments on the tensile forces of this iron, and also to repeat those with sections of the T form, which were found defective in former experiments. For this purpose a second application was made, through Mr. Murry of Glasgow, to the Company, who immediately furnished the necessary samples. Other sorts, the Muirkirk, the Coed-Talon No. 3, including the Carron No. 3 irons, have been obtained, and their results will be given in the present paper.

Before entering upon the experiments, I made application to the greater part of the works from whence iron was received, for information relative to the nature of the ores, fuel, flux, &c.; also for such analysis as the proprietors might be enabled or disposed to furnish, including the temperature of the air used in the process of smelting.

To these inquiries I received replies which, although of great importance in themselves, could not with propriety be introduced into this report.[*]

During the progress of the investigation, it was found desirable for Mr. Hodgkinson and myself to divide our labours; and in order to examine the different irons with the utmost care, the experiments were classed and apportioned in the manner described in Mr. Hodgkinson's report.

This division was attended with considerable benefit, as it excited a closer investigation of the subject; and the whole of the experiments being made at my works, gave a facility for comparison that could not otherwise be obtained.

In describing the following experiments, I will first give the tables and results on the transverse or more usually investigated species of strain, where the experiment was made without loss of time, and which may be considered a continuation of the same class of experiments by Mr. Hodgkinson. We shall then proceed to experiments on the Coed-Talon bars, in relation to time or indefinite strain. Afterwards we shall exhibit others on the effects of temperature; and finally close with a general summary of results.

Before presenting the experiments in their tabulated forms, it may be necessary to supply a brief description of each class, in order to show the methods adopted, and how the results were obtained.—For this purpose, a number of models were prepared, to be one inch and one and a half inch square; and the metals, both hot and cold blast, were run into the form of those models. But as there is generally a slight deviation in the size of the casting from that of the model, the dimensions of the bars were accurately measured at the place of fracture, and the results reduced (when practicable) by calculation to what they would have been if cast to the exact size of the model. This was done to ensure more accurate comparisons in the

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[*] Mr. Murray, of the Monkland Iron Work, has, however, supplied me with the following particulars relative to the Scotch irons, viz. the Carron and Devon irons, which are derived, like most of the Scotch metals, from argillaceous carbonate of iron, and are found in the coal-basins of the country. Some of the poorer ores are found in balls imbedded in argillaceous schistus, and worked or turned out with the coal; but the principal is a seam of black band, at a depth of 15 to 25 fathoms under the splint, or fifth seam of coal, of the Lanarkshire basin. This iron stone varies from 9 to 15 inches in thickness, and contains from 35 to 40 per cent. of iron. Two-thirds of this ore is generally used to each charge, and one-third of the poorer balls and bands containing from 20 to 25 per cent.—Dr. Colquhoun analyzed the black band ore, which gave,

Carbonic acid,	35.17	Peroxide of iron,	0.23
Protoxide of iron,	53.03	Calcareous or bituminous matter,	3.03
Lime,	3.33	Moisture and loss,	1.41
Magnesia,	1.77		
Silica,	1.40		100.00
Alumina,	0.63		

The specific gravity of this ore is 3.0553, colour close brown. The ore contains an intermixture of imbedded bivalve shells.

strength and other mechanical properties of the bars. The mode of reduction is described in the preceding report.

In addition to the methods herein adopted to determine the strength, tenacity, and value of the different irons made from hot and cold blast, I conceived it necessary to institute a series of microscopic observations; to examine with great minuteness the appearance of the fracture, and by magnifying the crystals, to elucidate such visible indications of the fluidity, strength, and ductility of the irons, as would distinguish the qualities of the different numbers known in commerce by the name of No. 1, 2, and 3 iron.

I also pursued in other respects a close and minute examination of the different specimens of hot and cold blast iron, and by turning, filing, grinding, &c., endeavoured to discover their properties in relation to each other, and their adaptation to the arts.

As the Carron No. 2 irons, hot and cold blast, were among the first we obtained, I have, in the description of the fractures attached to each table of experiments, made the Carron No. 2 cold blast iron the basis of comparison. It may therefore be proper to give here the following short description of it.

This iron, when viewed with a microscope, presents a dull gray colour, finely granulated, with an appearance of greater porosity in the centre than round the extreme edges of the fracture. It is a free-working iron, easily cut with the turning tool, but indicates stiffness under the file.

TABLE I.—North Wales Iron.—Coed-Talon No. 2 Pig-Iron, Cold Blast.

Experiment 1. Depth of bar, 1.042 Breadth of do. 1.021 Distance between supports, 4 ft. 6 in. Weight of bar, 5 ft. long, 16¼ lbs.			Experiment 2. Depth of bar, 1.061 Breadth of do. 1.018 Distance between supports, 4 ft. 6 in. Weight of bar, 5 ft. long, 16 lbs. 2 oz.			Experiment 3. Depth of bar, 1.04 Breadth of do. 1.02 Distance between supports, 4 ft. 6 in Weight of bar, 5 ft. long, 15 lbs. 9 oz.			Experiment 4. Depth of bar, 1.076 Breadth of do. 1.04 Distance between supports, 2 ft. 3 in.			Experiment 5. Depth of bar, 1.062 Breadth of do. 1.0[illegible] Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.
28	.057	..	28	.06	..	28	.072	..	112	.028	..	112	.030	..
56	.115	+	56	.122	+	56	.125	+	224	.060	..	224	.064	+
126	.299	.015	126	.297	.018	112	.269	.011	336	.092	+	336	.096	.005
154	.37	.023	154	.37	.027	168	.420	.024	448	.125	.006	448	.134	.007
182	.451	.032	182	.452	.035	224	.584	.042	560	.162	.008	560	.172	.010
238	.615	.06	238	.618	.059	280	.748	.064	672	.203	.010	672	.215	.014
294	.8	.08	294	.797	.083	336	.924	.085	784	.242	.016	784	.258	.020
350	.993	.115	350	.989	.114	392	1.105	.123	896	.290	.025	896	.308	.028
406	1.21	.162	406	1.202	.16	448	1.315	.185	952	.316		952	broke	
434	1.332	.195	434	1.32	.19	462	broke		1008	bo ke				
448	broke		448	1.386										
			462	broke										
∴ Ultimate deflection = 1 394. Broke 1¾ inch from the centre.			∴ Ultimate deflection = 1.452. Broke at the centre.			∴ Ultimate deflection = 1.364. Broke ½ an inch from the centre.			∴ Ultimate deflection = .341. Broke 1 3-8 inch from the centre.			∴ Ultimate deflection = .332. Broke ½ an inch from the centre.		

The microscopic appearance of this iron is a deeper gray colour than is exhibited in the Carron No. 2 cold blast; it is also more open than it is in the centre of the bar, with a diminution of the crystals as they approach the exterior skin. It is less ductile than the hot blast, and inferior to it in the power of resisting impact.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection (d).	Product $b \times d$ or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports.	6.951 6.916	14680000	404.2	1.453	587.3
Experiment 2nd, bar 4 ft. 6 in. between supports,	6.916	13947000	403.1	1.540	620.7
Experiment 3rd, bar 4 ft. 6 in. between supports,	7.038	14285000	418.8	1.419	594.2
Mean,	6.955	14304000	408.7	1.470	600.7
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	837.2	.367	307.2
Experiment 5th, bar 2 ft. 3 in. between supports,	..	..	836.6	.353	295.3
Mean,	..	..	836.9	.360	296.2

TABLE II.

North Wales Iron.—Coed-Talon No. 2 Pig-Iron, Hot Blast.

Experiment 1. Depth of bar 1.071 Breadth of do. 1.000 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 15¾ lbs.			Experiment 2. Depth of bar, 1.057 Breadth of do. 1.010 Distance between supports, 4 ft. 6 in. Weight of bar, 5 ft. long, 16 lbs.			Experiment 3. Depth of bar, 1.044 Breadth of do .994 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.065 Breadth of do. 1.002 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.
28	.065	..	28	.071	..	112	.031	..	112	.030	..
56	.130	.005	56	.130	.005	224	.070	..	224	.066	..
126	.325	.025	126	.329	.030	336	.109	+	336	.103	.005
182	.503	.052	182	.507	.056	448	.152	.007	448	.144	.007
238	.700	.085	238	.698	.089	560	.200	.012	560	.188	.011
294	.910	.120	294	.910	.124	672	.251	.020	672	.238	.019
350	1.149	.170	350	1.153	.184	784	.307	.030	784	.290	.028
406	1.420	.245	406	1.435	.265	840	.343		896	.355	.045
434	1.570	.295	462	1.764	.370	896	broke		952	.390	
448	1.654		469	broke					980	broke	
462	broke										
∴ Ultimate deflection =1.738. Broke ¾ of an inch from the centre.			∴ Ultimate deflection =1.808. Broke ½ an inch from the centre.			∴ Ultimate deflection =.375. Broke at the centre.			∴ Ultimate deflection=.407. Broke ⅜ of an inch from the centre.		

In this iron the crystalization is more perfect, when contrasted with the cold blast from the same ore; it presents larger granules than it, accompanied with more lustre over the whole surface of the fracture. It is a free, kindly-working iron; easily cut with the chisel, and files with a sense of adhesion to that instrument.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking Weight (b).	Ultimate deflection (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	6.970 6.956	15810000	402.8	1.861	749.6
Experiment 2nd, bar 4 ft. 6 in. between supports,	6.977	12835000	415.6	1.911	794.2
Mean,	6.968	14322500	409.2	1.882	771.9
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	835.5	.392	327.5
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	862.3	.434	374.2
Mean,	..	..	848.9	.413	350.8

Comparative results of Coed-Talon Iron No. 2.

Distance between supports 4 ft. 6 in. and 2 ft. 3 in.

Strength of Cold Blast Iron.	Strength of Hot Blast Iron.	Ratio of Strengths.
404.2 403.1 418.8 } Mean 408.7	402.8 415.6 } Mean 409.2	1000 : 1001
837.2 836.6 } Mean 836.9	835.5 862.3 } Mean 848.9	1000 : 1014
		Mean ratio of strength, 1000 : 1007

Results of products, and ratio to resist impact.

Product of strength by ultimate deflection in Cold Blast Iron.	Product of strength by ultimate deflection in Hot Blast Iron.	Ratio of products, or of power to resist impact.
587.3 620.7 594.2 } Mean 600.7	749.6 794.2 } Mean 771.9	1000 : 1285
307.2 295.3 } Mean 296.2	327.5 374.3 } Mean 350.8	1000 : 1184
		Mean ratio of powers to sustain impact, 1000 : 1234

Modulus of elasticity in lbs. for a base of an inch square.

Cold Blast Iron,	14680000	Hot Blast Iron,	15810000
Do.	13947000	Do. . .	12835000
Mean,	14313500	Mean,	14322500

Note.—The modulus of elasticity was taken in this, as well as in other cases, from the 4 ft. 6 in. bars, and from the deflection caused by 112 lbs.

TABLE III.—North Wales Iron.—Coed-Talon No. 3 Iron, Cold Blast.

Experiment 1. Depth of bar, .996 Breadth of do. 1.005 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth of bar, 1.035 Breadth of do. 1.017 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth of bar, .996 Breadth of do. 1.015 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.035 Breadth do. 1.017 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.067	..	28	.060	..	112	.030	..	112	.031	..
56	.131	+	56	.117	+	224	.068	..	224	.060	..
112	.257	.010	112	.231	.012	336	.102	+	336	.092	+
168	.400	.018	168	.357	.023	448	.140	+	448	.122	.005
224	.542	.030	224	.491	.036	560	.178	.006	560	.156	.007
280	.695	.047	280	.623	.050	672	.217	.008	672	.189	.009
336	.850	.064	336	.762	.069	784	.256	.012	784	.221	.011
392	1.022	.090	392	.910	.089	896	.300	.020	896	.257	.017
448	1.204	.121	448	1.070	.112	1008	.349	.031	1008	.300	.022
504	1.400	.164	504	1.238	.148	1064	.377	..	1120	.340	.031
532	1.520		560	1.425	.191	1120	.408	.045	1176	broke	
560	broke					1176	.439				
						1204	broke				
∴ Ultimate deflection = 1.617. Broke at $\frac{3}{4}$ of an inch from the centre.			Broke with the weight, 560 lbs., when put on again.			∴ Ultimate deflection = .453. Broke at the centre.			∴ Ultimate deflection = .359. Broke at the centre.		

On comparing the Coed-Talon No. 2, cold blast, with the No. 3 cold blast iron, it will be found that the strength, and also the power to resist impact, is decidedly in favour of the last iron; in the first instance, the proportions are as 537.8 to 408.7, in the latter, 831.2 to 600.7, being a ratio of nearly 24 per cent. in favour of the No. 3 iron. The colour of this iron is a dull gray, with considerable uniformity in its crystaline texture. It is a stiff iron, rather difficult to cut, and accompanied with a hard sensation under the file.

Results reduced to those of bars 1.000 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (*b*).	Ultimate deflection in inches. (*d*).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7265 7124	17276800	561.7	1.610	904.3
Experiment 2nd, bar 4 ft. 6 in. between supports,	..	16927200	514.0	1.475	758.1
Mean.	7194	17102000	537.8	1.542	831.2
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	1195.7	.4512	539.5
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	1079.0	.3715	401.0
Mean,	..	..	1137.3	.4113	470.2

TABLE IV.—North Wales Iron.—Coed-Talon No. 3 Iron, Hot Blast.

Experiment 1. Depth of bar, 1.002 Breadth of do. 1.005 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth of bar, 1.011 Breadth of do. 1.002 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth of bar, 1.015 Breadth of do. 1.015 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.017 Breadth do. 1.005 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.078	+	28	.071	..	112	.037	..	112	.035	..
56	.150	.007	56	.143	+	224	.073	..	224	.070	..
112	.296	.012	112	.290	.011	336	.109	+	336	.108	..
168	.458	.022	168	.450	.026	448	.147	.005	448	.146	+
224	.621	.038	224	.611	.041	560	.182	.006	560	.183	.007
280	.793	.054	280	.780	.060	672	.221	.008	672	.220	.009
336	.978	.074	336	.957	.080	784	.260	.011	784	.261	.011
392	1.170	.100	392	1.142	.103	896	.302	.017	896	.304	.018
448	1.380	.134	448	1.340	.138	1008	.349	.022	952	.328	..
476	1.488		476	1.450		1064	.378		1008	.352	.025
504	broke		504	broke		1092	broke		1064	.380	
									1120	broke	
∴ Ultimate deflection = 1.588. Broke ¾ of an inch from the centre.			∴ Ultimate deflection = 1.547. Broke ½ of an inch from the centre.			∴ Ultimate deflection = .390. Broke ¾ of an inch from the centre.			∴ Ultimate deflection = .404. Broke 1 inch from the centre.		

The Coed-Talon No. 3, hot blast, is a much clearer iron, with larger crystals than the cold blast, No. 3. It presents a more varied appearance in its crystaline form, with the usual porosity in the centre of the fracture. The colour is more brilliant than that of the last-mentioned iron. This is in many respects similar to the Carron No. 2, cold blast. It is reduced by the file and chisel with more ease than the iron last examined.

Results reduced to those of bars 1.000 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	6992	14732600	499.5	1.591	794.7
Experiment 2nd, bar 4 ft. 6 in. between supports,	6967 6952	14683200	492.1	1.564	769.7
Mean,	6970	14707900	495.8	1.577	782.2
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	1044.0	.3958	413.2
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	1077.5	.4108	442.7
Mean,	..	..	1060.7	.4033	427.9

Comparative results of Coed-Talon No. 3.

Distance between supports, 4 ft. 6 in. and 2 ft. 3 in.

Strength of Cold Blast Iron.		Strength of Hot Blast Iron.		Ratio of strengths.
561.7 514.0	537.8	499.5 492.1	495.8	1000 : 922
1195.7 1079.0	1137.3	1044.0 1077.5	1060.7	1000 : 932
		Mean ratio of strengths,		1000 : 927

Results of products and ratio to resist impact.

Products of strength by ultimate deflection in Cold Blast Iron.		Products of strength by ultimate deflection in Hot Blast Iron.		Ratio of products, or of power to resist impact.
904.3 758.1	831.2	794.7 769.7	782.2	1000 : 941
539.5 401.0	470.2	413.2 442.7	427.9	1000 : 910
		Mean ratio of powers to sustain impact,		1000 : 925

Modulus of elasticity in lbs. for a base of an inch square.

Cold Blast Iron,	17276800	Hot Blast Iron,	14732600
Ditto,	16927200	Ditto,	14683200
Mean,	17102000	Mean,	14707900

If we carefully examine the different experiments in these and preceding tables, it will appear obvious that the hot blast is in every instance the weaker iron, and whether it is viewed in the long or short specimens, the same marked difference in strength is apparent. It is also clear that the No. 3 hot blast is an iron of greater power than the second quality made by hot blast from the same ore. On contrasting the tables, it will be found that the No. 3 iron exceeds the No. 2 in its power to resist a transverse strain nearly one-fifth, and considerably more in its resisting power to sustain impact, this being in a ratio of 1000 to 766.

I have pointed out the defect of the No. 2 iron, not so much for comparison between the hot and cold blast, as from a desire to show the difference which in general exists between the two qualities. In preparing castings for the purpose of supporting great weights, it will be necessary to have reference to the No. 3 iron, as the best adapted for the purpose; it will be found safer than the richer sorts, and should therefore form a considerable part of the mixtures of these descriptions.

The ratio of difference between the hot and cold blast Coed-Talon No. 3, and the Coed-Talon No. 2, is considerable. In the No. 2 we have the hot Blast in the transverse strain a mere fraction stronger, and its power to sustain impact as 1000 to 1234. On the other hand, the No. 3 cold blast stands prominently forward in the ratio of 1000 to 927 for the transverse strength, and 1000 to 925 for the resistance to impact. I offer no opinion as to the cause of these discrepancies; they are correctly given in the experiments, and I must leave the reader to draw his own conclusions.

TABLE V.—English Iron.—Elsicar No. 1 Pig Iron, Cold Blast.

Experiment 1. Depth of bar, 1.033 Breadth of do. 1 025 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 15½ lbs.			Experiment 2. Depth of bar, 1.042 Breadth of do. 1.030 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 15¾ lbs.			Experiment 3. Depth of bar, 1.023 Breadth of do. 1.006 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.016 Breadth of do. .990 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
56	.151	..	56	.129	..	112	.030	..	112	.032	..
112	.291	.030	112	.260	.010	224	.062	..	224	.066	+
168	.444	.048	168	.410	.029	336	.095	+	336	.101	.005
224	.611	.064	224	.571	.044	448	.132	.005	448	.141	.007
280	.782	.087	280	.740	.063	560	.170	.008	560	.181	.010
336	.979	.114	336	.918	.090	672	.215	.011	672	.229	.018
392	1.185	.148	392	1.112	.122	784	.260	.017	784	.276	.022
448	1.390	.190	448	1.320	.161	896	.310	.025	896	.330	.030
476	broke		476	broke		952	broke		952	.355	
									1008	broke	
∴ Ultimato deflection = 1.496. Broke 1 in. from the centre.			∴ Ultimate deflection = 1.424. Broke at the centre.			∴ Ultimate deflection = .334. Broke ¾ of an inch from the centre.			∴ Ultimate deflection = .381. Broke ⅛ of an inch from the centre.		

It must be observed that the Elsicar is entirely cold blast iron, and is here compared with the Milton hot blast. Both irons are from the same ores, and are generally obtained under the same circumstances. In their relative properties there are, however, some slight discrepancies, arising from an admixture of 5 per cent. of Cumberland ironstone, introduced into the Milton iron during the process. The Elsicar is blown from coke, with cold blast, whilst the Milton is produced from 5 parts coal and 1 part coke, with hot blast.

This iron has a vitrified and glutinous appearance over the entire section of the fracture; there is great uniformity,—the crystals being nearly the same in the centre as those next the outer skin of the bar. It has a gray colour, intermixed with blue. Its working properties are of the first order, the action of filing being accompanied by a soft adhesive sound.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection in inches (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7.056 7.017	13410000	535.2	1.546	672.8
Experiment 2nd, bar 4 ft. 6 in. between supports,	7.017	14552000	425.6	1.484	631.6
Mean,	7.030	13981000	430.4	1.515	652.2
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	904.2	.342	309.2
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	986.3	.387	381.7
Mean,	..	..	945.2	.364	345.4

TABLE VI.—English Irons.—Milton, No. 1 Pig Iron, Hot Blast—Yorkshire.

Experiment 1. Depth of bar, 1.064 Breadth of do. 1.064 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 16 lbs. 9 oz.			Experiment 2. Depth of bar, 1.058 Breadth of do. 1.020 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long, 16lbs. 8 oz.			Experiment 3. Depth of bar, 1.090 Breadth of do. 1.047 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.067 Breadth do. 1.040 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
42	.103	+	42	.103	+	112	.033	..	112	.033	..
112	.294	.010	112	.298	.006	224	.066	+	224	.070	+
182	.499	.038	182	.518	.033	336	.103	.004	336	.110	.004
238	.685	.065	238	.710	.056	448	.143	.007	448	.153	.006
294	.892	.094	294	.922	.090	560	.186	.009	560	.200	.009
350	1.126	.139	350	1.160	.135	672	.236	.015	672	.250	.016
406	1.382	broke	406	1.430	.209	784	.286	.024	784	.306	.025
			420	broke		896	.350	.038	896	.372	.041
						952	broke		924	broke	
Broke $\frac{3}{8}$ of an inch from the centre.			∴ Ultimate deflection =1.492. Broke $1\frac{1}{4}$ inch from the centre.			∴ Ultimate deflection =.379. Broke at the centre.			∴ Ultimate deflection=.388. Broke $\frac{1}{4}$ of an inch from the centre.		

The general appearance of this iron is the usual central porosity of crystalization, which no doubt takes place in consequence of a greater degree of rapidity in the cooling on the outside than within. In the larger descriptions of castings these marks are particularly observable, as the interior mass retains its fluidity for some time after the exterior has assumed the solid form: the phenomena of crystalization are therefore completed under different influences, and hence arises the great and prominent difference which exists in the granulated surface of a large fracture. The working powers of the Milton iron are much akin to the Carron No. 2, cold blast: it possesses less lustre than the Elsicar, but has greater fluidity than appearances would indicate

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch	Breaking weight (b).	Ultimate deflection in inches (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7.016 6.977	11701000	337.1	1.471	495.8
Experiment 2nd, bar 4 ft. 6 in. between supports,	6.936	12248000	367.9	1.579	580.9
Mean,	6.976	11974500	352.5	1.525	538.3
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	765.3	.413	316.0
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	780.4	.414	323.0
Mean,	..	..	772.8	.413	319.5

Comparative results of Elsicar Cold Blast Iron, No. 1, and Milton Hot Blast, No. 1.

Distance between supports 4 ft. 6 in.

Elsicar.—Strength of the Cold Blast Iron.		Milton.—Strength of the Hot Blast Iron.		Ratio of the strengths
	Mean		Mean	
435.2 425.6	430.4	337.1 367.9	352.5	1000 : 819
904.2 986.3	945.2	765.3 780.4	772.8	1000 : 818
		Mean ratio of strengths,		1000 : 818

The products, and ratio to resist impact.

Product of strength by ultimate deflection in Cold Blast Iron.		Product of strength by ultimate deflection in Hot Blast Iron.		Ratio of products, or of power to resist impact.
	Mean		Mean	
672.8 631.6	652.2	495.8 580.9	538.3	1000 : 825
309.2 381.7	345.4	316.0 323.0	319.5	1000 : 925
Mean ratio of powers to sustain impact,				1000 : 875

Modulus of elasticity in lbs. for a base of an inch square.

Elsicar Iron (Cold Blast)		13410000	Milton Iron (Hot Blast)		11701000
Do.	do.	14552000	Do.	do.	12248000
	Mean,	13981000		Mean,	11974500

[TO BE CONTINUED.]

On Voltaic Combinations; with some account of the effects of a large Constant Battery; in a letter addressed to M. Faraday, Esq. By J. F. Daniell, Esq.

The author, pursuing the train of reasoning detailed in his preceding letters, enters into the further investigation of the variable conditions in a voltaic combination on which its efficiency depends: and the determination of the proper proportions of its elements for the economical application of its power to useful purposes. He finds that the action of the battery is by no means proportioned to the surfaces of the conducting hemispheres, but approximates to the simple ratio of their diameters; and hence concludes that the circulating force of both simple and compound voltaic circuits increases with the surface of the conducting plates surrounding the active centres. On these principles he constructed a constant battery consisting of seventy cells in a single series, which gave, between charcoal points, separated to a distance of three-quarters of an inch, a flame of considerable volume, forming a continuous arch, and emitting radiant heat and light of the greatest intensity. The latter, indeed, proved highly injurious to the eyes of the spectators, in which, although they were protected by gray glasses of double thickness, a state of very active inflammation was induced. The whole of the face of the author became scorched and inflamed, as if it had been exposed for many hours to a bright midsummer's sun. The rays, when reflected from an imperfect, parabolic, metallic mirror in a lantern, and collected into a focus by a glass lens, readily burned a hole in a paper at a distance of many feet from their source. The heat was quite intolerable to the hand held near the lantern. Paper steeped in nitrate of silver, and afterwards dried, was speedily turned brown by this light: and when a piece of fine wire-gauze was held before it, the pattern of the latter appeared in white lines, corresponding to the parts which it protected. The phenomenon of the transfer of the charcoal from one electrode to the other, first observed by Dr. Hare, was abundantly apparent; taking place from the *zincode* (or positive pole) to the *platinode* (or negative pole.) The arch of flame between the electrodes was attracted or repelled by the poles of a magnet, according as the one or the other pole was held above or below it; and the repulsion was at times so great as to extinguish the flame. When the flame was drawn from the pole of the magnet itself, included in the circuit, it rotated in a beautiful manner. The heating power of this battery was so great as to fuse, with the utmost readiness, a bar of platinum, one-eighth of an inch square: and the most infusible metals, such as pure rhodium, iridium, titanium, the native alloy of iridium and osmium, and the native ore of platinum, placed in a cavity scooped out of hard carbon, freely melted in considerrable quantities. In conclusion, the author briefly describes the results of some experiments on the evolution of the mixed gases from water in a confined space, and consequently under high pressure; with a view to ascertain, first, in what manner conduction would be carried on, supposing that the tube in which the electrodes were introduced was quite filled with the electrolyte, and there were no space for the accumulation of the gases; secondly, whether, decomposition having been effected, recombination would take place at any given pressure; and lastly, whether any re-action on the current-force of the battery would arise from the additional mechanical force which it would have to overcome. These experiments the author purposes pursuing at some future time. Athenæum.

Improved Method of Case-Hardening Iron.

Sir,—Among the other good qualities which render iron so valuable to the artisan, is the peculiar and important property which this metal possesses of being readily converted, either wholly or in part, into *steel.* The entire conversion of masses of iron into steel by cementation, is a process perfectly well understood and very fully explained in most works treating upon the subject of metals; but the partial conversion of the surface of various articles of iron, after being manufactured, is a process of even greater convenience if not of greater value, and one upon which I beg to offer a few remarks. In this manner various tools and instruments of common use, such as fire-irons, keys, bridle-bits, stirrups, &c. &c., are formed with great facility of soft iron, and by the subsequent conversion of their external surfaces into steel, by the process of *case-hardening*, they combine a toughness and a hardness not otherwise attainable. If formed wholly of hardened steel, brittleness would be their common defect; while if made of iron in its unaltered state the instruments would be altogether too soft for the purpose for which they were intended.

Innumerable articles are therefore continually manufactured from soft iron, which are subsequently coated with steel by an incipient kind of cementation. The method usually adopted has been to place the articles to be hardened, in an iron box filled with vegetable, or what is better, with animal charcoal; this box, with its contents, being exposed to the action of a strong fire for an hour or two, a partial conversion of the surface of the iron takes place, its depth being proportioned to the duration of the process, the size of the articles, &c. But the time is always incomparably shorter than would be necessary for the entire conversion of the whole mass of the metal. After remaining in the fire the proper time the box is taken out and its contents suddenly thrown into cold water, which effectually hardens the steel coat which has been produced. The articles thus treated are susceptible of a high degree of polish, which forms the finishing process.

This mode of case-hardening has the disadvantage of being inconvenient and tedious, and it has been recently improved by the employment of prussiate of potash (Ferrocyanodide of Potassium.)

Although this valuable discovery is of very recent date, I am unacquainted with its author; the fact is noticed as "*an improvement of great value*" in "Gill's Machinery Improved," and also in "Ure's Dictionary of Arts and Manufactures," both published at the beginning of the present year.

Notwithstanding these publications, this discovery is but little known, and a workman, within my own knowledge, a very short time since, purchased the "art and mystery" of case-hardening with prussiate of potash, as a "*valuable secret.*"

I trust, therefore, in calling the attention of your readers to the subject, I shall be diffusing a more extended knowledge of what I know experimentally to be a highly useful and convenient process.

For this purpose let the crystals of prussiate of potash be reduced to a coarse powder: having your iron articles well cleaned off, heat them at the forge to a bright red, take them out and strew some of the prussiate of potash over them, which will immediately fuse and spread upon the surface, return the article to the fire, and restore the heat, when sudden quenching in cold water will give the required hardness.

By this means, *case-hardening* is more effectually completed in *two minutes* than it could be in *two hours* by the old method; besides which, the workman has the power of case-hardening *part* of any iron instrument, while the remaining portion continues in its original state. This process is also applicable to many articles which could not be conveniently subjected to cementation, and may be applied to cast, as well as wrought, iron goods.

I remain, Sir, yours, respectfully,

Mech. Mag. WM. BADDELEY.

Amalgam for the Rubbers of Electrical Machines.

Fuse a small quantity of zinc either in a crucible or ladle, and pour it gently into about four times its weight of mercury, previously heated in a stone or iron mortar, and stir it well during the time with the warm pestle. Continue to rub the amalgam till quite cool, in order to incorporate the two metals completely; which, if well performed, will give the amalgam a smooth butter-like consistence. It may be made softer, if necessary, by adding mercury during the process. This amalgam, mixed with a very little tallow, is the best we have yet used. Sturgeon's Annals.

Notice or Alarm Gong.

A very ingenious instrument has been invented by Captain George Smith,

R. N., intended to give warning of the approach and to announce the course a steamer is sailing on in a fog. It consists of a gong, on which a hammer is made to strike, every ten seconds, a certain number of blows, by a very simple machinery, according to the course the vessel is sailing on. For example, if she be sailing north, the gong is struck once; if east, twice; if south, thrice; and if west, four times every ten seconds. By this systematic method, the position, course and proximity of a steamer will be clearly announced to any other vessel. In rivers, Captain Smith proposes the vessel to emit single sounds every ten seconds, which would be sufficient to give warning. Civil Eng. & Arch. Journal.

Progress of Physical Science.

Proceedings of the American Philosophical Society.

September 21, 1838—Mr. Du Ponceau, President, in the Chair.

Solar Eclipse, September, 1838.—The Committee on the solar eclipse of the 18th September, made a report in part, comprising the Observations made at Philadelphia, the principal results of which are as follows:

The observations made at Philadelphia are fifteen in number. A list of observers, telescopes, &c., is given in the following table. The correction in the third column is to be added algebraically to the latitude of the place of observation, to obtain that of the State House, + 39° 56′ 58″. The correction in the fourth column is likewise to be added to the local longitude in time, to obtain that of the State House,—*5h. 0m.* 39.*2s.*

No.	OBSERVER.	Reduction to Latitude of State House.	Reduction to Longitude of State House.	Focal length in feet.	Makers of Telescope.	Description.	Screen Glass.	Estimated power.
		″	s					
1	E. J. Beans	—70.0	+1.70	2.5	Unknown	Spy-glass	Smok'd	15
2	Wm. Penn Cresson	— 1.8	+5.20	2.5	Jones	Achromatic	Red	30
3	Prof. W. R. Johnson	— 1.8	+5.20	3.5	Dollond	do.	do.	100
4	George M. Justice	—10.0	+2.86	2.5	Jones	Gregorian	do.	80
5	E. O. Kendall	—10.0	+2.86	2.5	Plössl	Dialytic	Green	50
6	Joseph Knox	—21.0	—1.39	3.5	Dollond	Achromatic	Red	80
7	Isaiah Lukens	— 9.0	+0.86	1.8	Plössl	Dialytic	Yellow	20
8	Thomas M'Euen	+ 0.4	+2.33	2.5	Dollond	Achromatic	Red	60
9	Prof. Roswell Park	— 6.5	+1.30	2.5	do.	Gregorian	do.	50
10	Dr. R. M. Patterson	— 1.1	+1.20	5.0	do.	Equatorial	do.	100
11	Wm. H. C. Riggs	+ 0.4	+2.33	3.5	do.	Achromatic	do.	50
12	Samuel Sellers	— 7.5	+0.05	2.5	Jones	do.	do.	40
13	Tobias Wagner	—10.0	+2.86	3.5	Dolland	do.	do.	80
14	Sears C. Walker	—10.0	+2.86	5.0	Tulley	do.	do.	100
15	William Young	+21.0	—1.39	7.0	Holcomb	Herschelian	do.	200

Phases Observed, in Mean Times of the Places of Observation.

No.	A. *h m* 3 13	B. *h m* 4 30	C. *h m* 4 31	D. *h m* 4 31	F. *h m* 4 31	H. *h m* 4 35	I. *h m* 4 35	K. *h m* 4 35	L. *h m* 4 35	M. *h m* 4 41	N. *h m* 5 45	O. *h m* 5 45	P. *h m* 5 45
			s			*s*							
1			3.9			28.4							
2	*s*		−7.0		*s*	27.8	*s*	*s*			*s*	*s*	
3	10.7		10.5	*s*	15.5	23.5	27.5	29.0			4.2	12.2	
4	7.4		6.3	12.8		27.3						11.3	
5	8.3			10.9		28.4						12.9	
6	12.8												
7				21.7				36.2					
8	•3.0			18.1		29.1						13.2	
9		*s*		19.1		29.1				*s*			*s*
10	7.0	39 1		19.1		30.1				23.1		16.1	19.1
11	7.3	39.2	2.3	16.3		29.4		36.3				7.8	
12	6.0			16.0		31 0						16.0	
13	6.1								*s*				
14	5.6	36.7		15.6	23.0	28.0	29.5	37.0	42.0		10.0	13.0	16.0
15				12.9				38.9				15.0	

• Doubtful.

A. *Beginning.* Prof. Johnson noticed dark indentations for eight seconds after the first disturbance of the limb.

B. Arch of faint light, with speck or brush in centre, round the moon's limb beyond the cusps; brush or blaze in centre, between cusps, extending outwards about two digits. One cusp broken at end, presenting a bright bead.

C. Arch of light much increased in brightness; the brush or blaze, at first in the centre, now extends from cusp to cusp; radiation outwards, nearly three digits; cusps distant 30° on sun's limb, a broken point or bead at each end. This phase noted as that of the formation of the ring by Nos. 1, 2, 3, 4, and 11.

D. *Formation of ring, or instant of osculation of limbs.* This phase noticed as the approach of two sharp well defined points to a contact by Nos. 5 and 15. It was observed at the instant when the cusps, apparently 20° of the sun's limb apart, suddenly united by the extension of four or five luminous beads, or rounded portions of the sun's disc, by Nos. 3, 4, 8, 9, 10, 11, 13, and 14.

E. Omitted in the table. This letter refers to the time when the dark lines, described by Van Swinden and Bailey, should have appeared. They were not seen by any observer, though carefully searched for.

F. Perfect ring, the beads of light having united, or run into each other suddenly.

G. Counterpart of E, not observed though looked for.

H. *Rupture of ring*, counterpart of D. Took place at a point, and so noted by all the observers.

I. Appearance of beads, five or six in number, extending from cusp to cusp.

K. Counterpart of C in every respect.

L. Counterpart of appearance just preceding C. Brush or blaze of light, narrowed down to a small space, 3° or 4° on the moon's border, extending outwards 2½ digits; cusps still broken, as seen by most of the observers. Nos. 5 and 15, however, saw no irregularity of cusps, no beads of light.

M. Final disappearance of arch of faint light, with brush of light extending beyond the middle, having previously become very faint. This phenomenon observed with great care and certainty by No. 10.

N. Appearance of dark lines extending into the sun's disc, noticed by Nos. 3, 4, 10, and 14. The time noted by Nos. 3 and 14 as the end of the eclipse.

O. *End of eclipse*, inferred by each observer from his notes.

P. Final disappearance of the dark lines, the sun's disc having resumed its natural shape. Nos. 3, 4, 10, and 14 inferred the time of O as at some instant intermediate between N and P. The time of external contact difficult to determine, on account of this irregularity.

For the convenience of computers, the local times above given have been reduced to their corresponding value for the State House by E. O. Kendall, by means of his formulæ, in Vol. XX. of the Journal of the Franklin Institute, p. 125, which gives the following values for the variation of the local times of the several phases, for a small variation of terrestrial latitude or longitude, as follows:—

	Beginning.	*Ring.*	*End.*
	s	*s*	*s*
Variation for + or north 1″ terr. lat. =	—0.0397	—0.0382	—0.0343
Do. + or east 1*s* of terr. lon. in time =	+1.2600	+ 1.1400	+0.9925

The means of his results for the State House, giving to each observation its proper weight, in mean time of the State House, are,

	h	*m*	*s*
Beginning, ...	3	13	10.06
Formation of ring, . . .	4	31	18.76
Rupture of ring, ...	4	35	31.35
End, ...	5	45	15.46
Duration of eclipse, . . .	2	32	5.40
Duration of ring, ...		4	12.59

Language of the Valiente Indians.—Mr. Du Ponceau presented a communication, entitled "A Vocabulary of the Language of the Valiente Indians, who inhabit the State of Costa Rica, in Central America, by Col. D. Juan Galindo, of Guatemala." Referred to the Historical and Literary Committee.

New Formulæ, relative to Comets.—Mr. Nulty read a mathematical paper, entitled "New Formulæ relative to Comets, by E. Nulty, of Philadelphia.' Referred to Dr. Patterson, Mr. Walker, and Capt. Talcott.

The subject of this paper was the component velocities of a comet, observed at three consecutive and moderately small intervals of time. In a preliminary notice of his subject and the means employed in its development, the author mentioned some advantages which he conceived to be attached to his peculiar mode of investigation. He alluded to different results already known, and, with several novel and general formulæ comprised in his paper, he announced two new sets of expressions which he represented as being directly applicable to the exceptive cases, in which particular observations render the forms hitherto given, doubtful or indeterminate. He also noticed a numerical application which he made of his formulæ and of others connected with the method of Laplace, to the data of the comet of 1803; and he intimated that a comparison of the results obtained by him in that and other instances, had led him to some remarks, which he inserted towards the close of his paper, from his opinion of their analytical and practical importance.

Depth of the Sea.—Dr. Patterson read a paper by Professor Charles Bonnycastle, of the University of Virginia, containing "Notes of Experiments, made August 22d to 25th, 1838, with the view of determining the Depth of the Sea by the Echo."

This paper, which was not offered for publication in the Society's Transactions, states that the generally received notions in regard to the intensity of sound in water, and the distance to which it is conveyed, had suggested to Mr. Bonnycastle, some years ago, the idea that an audible echo might be returned from the bottom of the sea, and the depth be thus ascertained from the known velocity of sound in water. The probability of this view was deemed at least sufficient to justify an experiment; and accordingly the Navy Commissioners authorized the construction of the necessary apparatus, and Captain Gedney, of the U. S. Brig Washington, attached to the coast survey, volunteered his services and the use of his vessel, and authority to this effect was liberally granted by the Secretary of the Treasury, Mr. Woodbury.

The apparatus, which is fully described in Mr. Bonnycastle's paper, consisted, first, of a petard or chamber of cast iron, 2½ inches in diameter and 5¾ inches long, with suitable arrangements for firing gunpowder in it under water; secondly, of a tin tube, 8 feet long and 1¼ inch in diameter, terminated at one end by a conical trumpet-mouth, of which the diameter of the base was 20 inches, and the height of the axis 10 inches; thirdly, of a very sensible instrument for measuring small intervals of time, made by J. Montandon of Washington, and which was capable of indicating the sixtieth part of a second. Besides these, an apparatus for hearing was roughly made on board the vessel, in imitation of that used by Colladon in the Lake of Geneva, and consisted of a stove-pipe, 4½ inches in diameter, closed at one end, and capable of being plunged four feet in the water. The ship's bell was also unhung, and an arrangement made for ringing it under water.

On the 22d of August, the brig left New York, and in the evening the experiments were commenced. In these, Mr. Bonnycastle was assisted by the commander and officers of the vessel, and by Dr. Robert M. Patterson, who had been invited to make one of the party.

In the first experiments, the bell was plunged about a fathom under water and kept ringing, while the operation of the two hearing instruments was tested at the distance of about a quarter of a mile. Both instruments performed less perfectly than was expected; the noise of the waves greatly interfering, in both, with the powers of hearing. In the trumpet-shaped apparatus, the ringing of the metal, from the blow of the waves, was partly guarded against by a wooden casing; but, as it was open at both ends, the oscillation of the water in the tube was found to be a still greater inconvenience, so that the sound of the bell was better heard with the cylindrical tube. At the distance of a quarter of a mile this sound was a sharp tap, about the loudness of that occasioned by striking the back of a penknife against an iron wire: at the distance of a mile the sound was no longer audible.

In the second experiments, the mouth of the cone, in the trumpet apparatus, was closed with a plate of thick tin, and both instruments were protected by a parcelling of old canvas and rope-yarn, at the part in contact with the surface of the water. In these experiments the cone was placed at right angles to the stem, and the mouth directed toward the sound. The distances were measured by the interval elapsed between the observed flash and report of a pistol. At the distance of 1400 feet, the conical instrument was found considerably superior to the cylindrical, and at greater distances the superiority became so decided, that the latter was abandoned in all subsequent experiments. At the distance of 5270 feet, the bell was heard with such distinctness as left no doubt that it could have been heard half a mile further.

The sounds are stated in the paper to have been less intense than those in air, and seemed to be conveyed to less distances. The character of the sound was also wholly changed, and, from other experiments, it appeared that the blow of a watchmaker's hammer against a small bar of iron gave the same sharp tick as a heavy blow against the large ship's bell. It is well known that Franklin heard the sound of two stones struck together under water at half a mile distance; yet two of the boat's crew, who plunged their heads below the water, when at a somewhat less distance from the bell, were unable to hear its sound.

On the 24th of August, the vessel having proceeded to the Gulf Stream, experiments were made with the view for which the voyage was undertaken; that is, to ascertain whether an echo would be returned, through water, from the bottom of the sea. Some difficulties were at first presented in exploding the gun under water, but these were at length overcome. The hearing-tube was ballasted so as to sink vertically in the water. The observers then went, with this instrument, to a distance of about 150 yards from the vessel, and the petard was lowered over the stern, about three fathoms under water, and fired. The sound of the explosion, as heard by Mr. Bonnycastle, was two sharp distinct taps, at an interval of about one-third of a second. Two sounds, with the same interval, were also clearly heard on board the brig; but the character of the sounds was different, and each was accompanied by a slight shock. Supposing the second sound to be the echo of the first from the bottom of the sea, the depth should have been about 160 fathoms.

To ascertain the real depth, the sounding was made by the ordinary method, but with a lead of 75 pounds weight, and bottom was distinctly felt at 550 fathoms, or five furlongs. The second sound could not, therefore, have been the echo of the first; and this was proved, on the following day, by repeating the experiment in four fathoms water, when the double sound was heard as before, and with the same interval.

The conclusion from these experiments is, either that an echo cannot be heard from the bottom of the sea, or that some more effectual means of producing it must be employed.

Dr. Hare suggested the expediency of employing the Galvanic fluid to fire gunpowder below the surface of water, in experiments similar to those of Professor Bonnycastle.

Fusion of Platinum.—Dr. Hare laid before the society a specimen of platinum, weighing between twenty-two and twenty-three ounces, being part of a mass of twenty-five ounces, fused by him in May last, by means of his compound blowpipe.

Tornado.—Dr. Hare also mentioned that he had observed, during a recent tornado at Somerset, Mass., various circumstances, which he detailed, all leading to the conclusion that a hiatus or place of rest exists at the centre of motion of the tornado.

October 5.—Mr. Du Ponceau, President, in the Chair.

Solar Eclipse.—The Committee on the solar eclipse of the 18th of September, made a further Report in part.

This portion of the report embraced the observations made in the vicinity of Philadelphia, of which the following are the principal results, arranged in the order in which they were received, and, with one exception, in mean time of the place of observation; the longitudes being reckoned from Greenwich.

No. 16, by Robert Treat Paine, Esq., at the west front of the Capitol, Washington. Latitude 38° 53′ 23″, as determined by Mr. Paine, with his Troughton's sextant. Longitude *5h 8m 6s* west. With 3½ feet equatorial, green screen glass. Time by three chronometers, regulated by eastern and western altitudes of sun and stars, with his Troughton's sextant.

	h	*m*	*s*
Beginning,	3	6	9.58
Formation of ring,	4	24	28.15
Rupture of ring,	4	30	18.55
End,	5	39	54.89
Duration of eclipse,	2	33	45.31
Do. of ring,		5	50.40

"The ring formed instantaneously, and broke nearly so. No beads were seen, nor the dark lines mentioned by Mr. Bailey, nor the light round the moon, although all were looked for. No distortion of the moon's limb could be seen, and the cusps of the sun, before the ring formed, were as sharp as needles."

No. 17, by Lieut. Gillies, U. S. N., at the Marine Observatory, Washington City, N. 8″, W. 0.08*s* in time, from the Capitol, with a 3½ feet achromatic, green screen glass, power 50. Astronomical clock regulated by a five feet transit instrument.

	h	*m*	*s*
Beginning,	3	6	10.4
Formation of ring,	4	24	28.4
Rupture of ring,	4	30	18.9
End,	5	39	56.4
Duration of eclipse,	2	33	46.0
Do. of ring,		5	50.5

"At beginning of eclipse, limbs sharp and well defined. The same at formation and rupture of the ring, only in the former the light seemed to flash round the moon's limb." Two detached, arched portions of the ring were seen separated from the cusps, "while the space between presented points of light (beads) only."

No. 18, by Prof. Elias Loomis, at the Observatory of the Western Reserve College, Ohio. Latitude 41° 14′ 42″ N. Longitude *5h 25m 35s* W. With a five feet equatorial, mounted on a stone pier under a revolving dome, with yellow screen glass, power 150, nearly. Astronomical clock regulated by a 20 inch transit circle by Simms.

Beginning 14*h* 27*m* 26.7*s* siderial time.

Other phases lost by clouds.

Nos. 19, and 20, by J. Gummere and his son S. J. Gummere, at the Haverford School Observatory, Chester County, Pa. Latitude 41° 1′ 12″ N.

Longitude 5*h* 1*m* 16*s* W. With two 3½ feet telescopes by Tulley, with red screen glasses, powers 75, nearly. Astronomical clock regulated by a Dolland's portable transit instrument.

	h	m	s
Beginning,	3	12	17.2
Formation of ring,	4	30	29.2
Rupture of ring,	4	34	44.8
End,	5	44	28.7
Duration of eclipse,	2	32	11.5
Do. of ring,		4	15.6

Arch of faint light, with brush in centre, seen before the formation of the ring. Arch seen after rupture, brush of light not recollected. Formation and rupture of the ring, by broken portions of the sun's border, several in number, not round like beads, but arched portions of the ring. These continued several seconds, and then suddenly united in the first instance, and separated in the last, without, however, exhibiting the dark lines figured by Bailey.

Nos. 21 and 22, by Charles Wister and his son Caspar E. Wister, at the Observatory of the former, Germantown. Latitude 40° 1′ 59″. Longitude 2.7*s* in time west of the State House. With a 2½ feet achromatic and a 2 feet Gregorian reflector. Astronomical clock regulated by a 3 feet transit instrument.

	C. Wister.			C. E. Wister.		
	h	m	s	h	m	s
Beginning,	3	12	55.4	3	12	54.4
Formation of ring,	4	31	9.4	4	31	8.4
Rupture of ring,	4	35	18.4	4	35	18.4
End,	5	45	8.4	5	45	7.4
Duration of eclipse,	2	32	13.0	2	32	13.0
Do. of ring,		4	9.0		4	10.0

"The lucid points and dark intervening spaces corresponded closely to Bailey's description."

No. 23, by John Griscom. Latitude 9.7″ N. Longitude 0.3*s* in time west of the Observatory of Haverford school. With a 3½ feet Dollond achromatic, power 80.

	h	m	s
Beginning,	3	12	18.6
Formation of ring,	4	30	31.6
Rupture of ring, (not reported.)			
End,	5	44	26.6
Duration of eclipse,	2	32	8.6
Do. of ring, (not reported.)			

No. 24, by Prof. James Hamilton, of Burlington, New Jersey. Latitude 40° 5′ 10″ N., 69.1*s* in time east of State House, Philad.—With a five feet achromatic, power 80. Clock regulated by equal altitudes with a sextant.

	h	m	s
Beginning,	3	14	23.7
Formation of ring,	4	32	32.6
Rupture of ring,	4	36	19.6

	h	m	s
End,	5	46	8.5
Duration of eclipse,	2	31	44.8
Do. of ring,		3	47.0

"The phases of the ring are the perfect formation and perfect rupture, without reference to beads. No dark lines seen."

October 19.—Dr. CHAPMAN, Vice President, in the Chair.

Solar Eclipse.—The Committee on the solar eclipse of the 18th of September, made a further Report in part, comprising the following observation:—

No. 25, by F. R. Hassler, Esq., at Weasel Mountain, N. J., latitude 40° 52′ 35″, approximate longitude 4*h* 57*m* 25.7*s* W., being one of the stations of the coast survey, with telescopes of the large theodolite, powers 116 and 151.

	h	m	s
First contact,	3	15	56.98
Inner contact,	4	35	57.09
End,	5	47	13.10
Duration of eclipse,	2	31	16.12
Do. of ring,			1.00

From a drawing, accompanying Mr. Hassler's communication, it appears that several broken portions of the ring, or beads of light, for a second only, extended from cusp to cusp, presenting a most beautiful appearance. During the rest of the eclipse, except this single second, the cusps were dull and rounded off at the end.

Natural History of Coal.

It is now universally allowed, that coal is the product of decomposed vegetable matter; and there are two hypotheses as to the mode in which it is brought together in such vast quantities. Deluc, Brongniart, Dr. Macculloch, and Mr. Hutton, of Newcastle, think that the plants generally grew and died on the spot where the coal exists, and that a bed of coal was analagous in its origin to a peat-bog. The other hypothesis (which is perhaps more generally received) assumes that the vegetable matter was swept from the land into estuaries or lakes by inundations and streams, as the trunks and branches of the trees, with roots and foliage, are carried down by the Mississippi and St. Lawrence in North America. The difficulty of accounting for the immense accumulations of vegetable matter spread over such extensive areas, is great in either way. But without going into the comparative merits of the two hypotheses, the former is assumed as true, for the purpose of illustration, in the following remarks:—

Coal was analogous in its origin to modern peat, and each bed was most probably formed on an extended surface of marshy land, covered with a rank vegetation. The finest caking coal Mr. Hutton considers as a crystaline compound, whose constituents had been in a state of solution; but slate coal and cannel coal often bear distinct impressions of plants. The new method of cutting minerals into slices so thin as to be transparent, of which Mr. Witham has made so happy a use, has been applied to coal; and by examining these with the microscope, the vegetable structure has been detected where no external trace of it was visible. In cannel coal it exists throughout the whole mass, while the fine coal retains it only in small patches, which appear, as it were, mechanically entangled. Among other indications of the ligneous origin, tubes have been discovered filled with a yellowish resinous matter, which is the most volatile part of the coal, being what is first driven off by heat. All coal, therefore, had originally existed in the state of plants or trees. About three hundred species have been found in the sandstone and shale of the coal measures; and the greater part of these probably exist in the coal itself, though the tenderness and opaqueness of the material render it difficult to detect them by examination. The three hundred species are all extinct. About two-thirds of them are ferns; the others consist of large Coniferæ (allied to the pine,) of gigantic Lycapodiaceæ, of species analogous to the Cactæ and Euphrobiaceæ, and of palms. The plants indicate a moist climate, as hot as that of the tropics; and this holds true in the coal plants, not only in England, but at Melville Island within the polar circle. Dr. Hutton thought that the vegetables had been carbonized by heat; but Dr. Macculloch contends, on good grounds, that the change has been effected solely by water and pressure, and that by these agents peat is capable of conversion into coal. In the coal, therefore, familiarly used in our houses, we have the forests of primeval times, deprived of their watery and volatile parts, but preserving all their combustible matter, laid up for our use, as it were, in vast cellars under our feet, closely packed, and protected from air, rain, and floods, by a solid covering of rock and soil.

The other hypothesis is thus explained by Professor Phillips, with reference to the coal formation of Yorkshire. The alternating beds he attributes to alternating currents from different points of the compass, charged with different sediments, and passing into a great estuary or lake. Lime, he thinks, was transported by the marine currents from the south-east, because the limestone beds are thickest in that direction, and thin off towards the opposite point: argillaceous sediment was swept in by a river from the west, the shales being thickest in that direction; while sand and floating wood were drifted from the north, the beds of coal and sandstone being thickest in that direction.

This hypothesis, like the other, involves various difficulties, of which two may be mentioned. Of the four currents bearing wood, sand, clay, and lime, how did it happen that three so generally suspended their action, while the fourth was operating? Again, supposing the wood to be floated from the north by a river which inundated its banks like the Mississippi, it is plain that such a stream could carry off only a small part, probably not one thirtieth, of the spoils of the forest annually deposited in its hydrographical basin.

It follows, that to furnish materials for a bed of coal extending over a given space, the river must have drawn its waters from an area thirty times as large as would be required if the wood was carbonized where it grew, or the period must have been thirty times as long. But, looking to the extent (once much greater than it now is) of the coal formations in the north of England and Scotland, where is the continent to be found in which such a river could exist? Mr. Phillips, in fact, finds it necessary to admit, that the large tracts of land required to furnish the sediments of sand and clay, and the masses of vegetable matter, have disappeared in the northern and western oceans. The fossils of the coal measures are chiefly plants. They are most abundant in the shale, but are also found in the sandstone. They generally lie on their sides; but various examples have been found of trees standing erect, piercing through several beds, with their roots spread out, and so circumstanced as to lead to the conclusion that they have been converted into stone at the very spot where they grew. Fossil trees seldom exceed a few feet in length; but examples are cited of some twenty feet long, found in what is considered their native locality. Their roots are sometimes in sandstone, but more frequently in a bed of shale, which had originally consisted of fine mud, and formed the soil in which they grew. Trees which had been transported from their native seats are, however, infinitely more common, and these have been found of great length. A magnificent specimen was exposed in Craigleith quarry, in 1833. Its colour approaches to black; it is about three feet in diameter; and there were above twenty feet of its length exposed when I saw it in 1834. It has no branches, but the scars where branches had been inserted are well marked. It has been ascertained, by slicing, to be a Conifera of the genius Araucaria, of which living species exist in New Holland. Like its modern type the fossil tree wants those concentric rings which mark the annual additions made to the growth of pines. It penetrates the sandstone obliquely, at an angle perhaps of twenty degrees. —*Maclaren's Sketch of the Geology of Fife and the Lothians.*

Mining Review.

Optical Phenomena. Measurement of Intensity of Light. British Association of Birmingham, August 26th.

Prof. Daubeny exhibited the model of an apparatus, by means of which, in a more complete condition, he hoped to obtain a numerical estimate of the intensity of solar light at different periods of the day, and in different parts of the globe. The contrivance consisted of a sheet of photogenic paper, moderately sensible, rolled round a cylinder, which, by means of machinery, would uncoil at a given rate, so as to expose to the direct action of the solar rays, for the space of an hour, a strip of the whole length of the sheet, and of about an inch in diameter. Between the paper and the light was to be interposed a vessel, with plane surfaces of glass at top and bottom, and in breadth corresponding to that of the strip of paper presented. This vessel, being wedge-shaped, was fitted to contain a body of fluid of gradually increasing thickness, so that, if calculated to absorb light, the proportion intercepted would augment in a gradually increasing proportion from one extremity of the vessel to the other. Hence it was presumed that the discoloration arising from the action of light would proceed along the surface of the paper to a greater or less extent, accordingly as the intensity of the sun's light was such as enabled it to penetrate through a greater or lesser thickness of the fluid employed. In order to register the results, nothing more was required than to measure, each evening, by means of a scale, how many degrees the discoloration had proceeded along the surface of the paper exposed to light, during each successive hour of the preceding day. To render the instrument self-registering, some contrivance for placing the paper always in a similar position with reference to the sun, must of course be superadded. The object of this contrivance differed from that aimed at by Sir J. Herschel in his Actinometer, being intended as a measure of the aggregate effect of the solar intensity at the period (be it long or short) during which the paper was submitted to its influence; whereas the Actinometer merely measures the intensity at the moment the observation is made. The interposition of an absorbing fluid has at least this advantage, that it enables the observer to estimate the relative intensity by marking the point at which the paper ceases to be discolored, of which the eye is able to judge more exactly than it could do of the relative darkness of shade which might be produced on paper exposed unprotected to light of different degrees of brilliancy.

Mr. Jackson thought that a Heliostat, for throwing the reflected light of the sun upon the instrument, would be objectionable; and suggested, in preference, that the Heliostat should rather turn the instrument to the sun, which he considered could be effected with equal ease.—Dr. Daubeny assented.—Prof. Forbes only first saw the instrument yesterday; he therefore could not speak with much confidence, but must own his first impressions were not very sanguine of its ultimate success. One objection was, the difficulty, if not impossibility, of procuring prepared or photogenic paper of exactly similar sensibility; and unless this were done, not even the observations of the same person, made at different times, could be compared, much less could any comparisons be made of the results of different observers. Another objection was the difficulty of observing where the discoloration extended to, as the shading off would be so gradual; so that different persons would come to different conclusions, according to the goodness or badness of their sight, upon the very same sheet of register paper. A third objection was, that the facts would be so complicated, that he much feared whether any scale could be formed; for not only were the quantities of light which would be permitted to pass through a wedge-shaped mass of fluid, such as Dr. Daubeny proposed, diminished, in a geometrical proportion, as its thickness increased arithmetically, but it had now been clearly established by the researches of Melloni, Fresnel, and others, that the portion of light which had already passed through a portion of any medium, was in a state for passing with greater ease, or in a greater relative proportion, through equal portions of the remainder. Unquestionably, self-registering instruments of all kinds were highly desirable, and an instrument fitted to perform what Dr. Daubeny proposed would be both interesting and valuable; and he thought the suggestions valuable, even supposing difficulties such as he alluded to should be found to exist.—Dr. Daubeny said, that, as to one of the objections, Sir John Herschel had informed him that any quantity of equally sensible photogenic paper could be obtained; as to the scale, the indications were not intended to furnish absolute, but only relative, results.

Athenæum.

Mechanics' Register.

The Patent Safety Fuze.

Before the invention of the Patent Safety Fuze, the loss of life in the Cornish mines was frightful. No one, unless entirely destitute of benevolence, could then take up a newspaper without having his soul harrowed with the heart rending accounts of mutilation and loss of life, arising from premature explosions in blasting. Nearly every week the shocking details were before us. To one, the light of heaven was no longer a blessing,—another, passed the remainder of his life a maimed man, while many left widows and children to helpless lamentation and starving want. The Safety Fuze was introduced—mine after mine adopted it—and, in proportion as the circle of its use became wider, the accidents within that circle became fewer. At the present time being used in nearly all the mines in Cornwall, nearly all the accidents from premature explosions have ceased. The Fuze is about three-sixteenths of an inch in diameter, and has the appearance of varnished cord. Its advantages over every thing previously used are many and striking. The time of the labourers is saved; no needle being used, no time is lost in priming, making touch paper, &c. The Fuze is placed in the charge, tamped up, and immediately fired. It burns so slowly (about thirty inches a minute) as to afford ample time for the labourers to retire. It is certain—not one in a thousand fails—with care, not one in a million. Disregarding the saving in time and certainty (and this is immense), the whole expense of the Fuze is saved in gunpowder alone. Owing to the size of the nail-hole in the common process, much of the power of the powder escapes; the whole of this is saved, and it amounts, as proved by experiment, to fully one-fifth of the gunpowder used. It is equally applicable to wet ground as to dry; for conveying fire 200 feet under water as through the air, or beneath the earth. Combining, then, certainty, economy, and safety, the patentees offer the Safety Fuze to the world as one of the most useful inventions of the nineteenth century.—*North Derbyshire Chronicle.*—[We readily add our testimony to that of our contemporary, as to the advantages attendant on the use of the Safety Fuze, having, in every instance where we are interested (so far as we have had the opportunity), enforced its application, as not only tending to, and we might also say ensuring, the safety of life, but as being more economical. We wish that the press in the mining districts would direct their attention to this important subject.—*Ed. Mining Journal.*]

Cheap Hygrometers.

Very many plants, and parts of plants, are sensitively hygrometric, and foreshow the changes of weather. One of the simplest and most certain of hygrometers is a well twisted cord saturated with salt, and stretched tight along a wall, with a plummet suspended from the centre. And a most curious automaton may be made by glueing deal boards together edgeways, and sawing off a strip across the grain; through this drive four nails, two at each end, all inclining the same way; place it in a large empty room, and and as the weather changes, the fore-end will advance, and then draw the hinder part after it, and so crawl across the room, in the manner of an earthworm, which is furnished in like manner with four rows of little hooks pointing to the tail.

Farm. Mag.

Improvement in Gloves and Stockings.

The hosiers of Nottingham and Leicester are making gloves and stockings having bands of Indian-rubber web knitted at the wrists, and under the knees instead of garters; a patent has been obtained for the invention, and licences, at £5 a-year each, are sold to the frame-work knitters.—*Nottingham Review.*—[In the Rolls Court on Saturday last an injunction was applied for by the London Caoutchouc Company—as the proprietors of Siever's patents, to restrain these Nottingham manufacturers from using the elastic web in this way. The matter was partially compromised by the infringers paying the patentees 10*l.* as an acknowledgment of their right—and on being permitted to sell the stock of gloves and stockings they had on hand.]

Mech. Mag.

LUNAR OCCULTATIONS FOR PHILADELPHIA, JANUARY, 1840.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
19	9	48	Im. q Cancri	6	105°	53°
19	10	47	Em.		207	159
20	8	34	Im. α Leonis	1	24	332
20	9	18	Em.		290	238
23	16	17	Im. χ Virginis	6	57	57
23	17	40	Em.		221	201

Meteorological Observations for July, 1839.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P. M.	Direction.	Force.		
				Inch's	Inch's			Inches.	
	1	65	83	30.00	30.00	S.W.	Moderate.		Lightly cloudy—clear.
	2	68	79	.00	29.90	S.S.E,	do.	.15	Cloudy—rain.
☽	3	67	80	29.70	.70	W.	do.		Cloudy—clear.
	4	65	82	.70	.75	W.	do.		Clear—do.
	5	58	74	.70	.70	N.	do.		Clear—lightly cloudy.
	6	59	75	.90	.85	N.	do.	. 8	Clear—rain.
	7	59	68	.80	.85	W.	do.		Clear—do.
	8	62	79	.65	.85	W.	do.		Clear—do.
⊗	9	62	82	.90	.90	W.	do.		Clear—do.
	10	66	86	.90	.85	W.	do.		Clear—do.
	11	71	86	.63	.55	S.S.W.	Calm.	.14	Cloudy—rain.
	12	66	77	.55	.55	S.S.W.	do.		Cloudy—clear.
	13	62	77	.90	.75	W.	Moderate.		Clear—do.
	14	66	77	.75	.70	W.	Brisk.		Cloudy—do.
	15	62	76	.50	.50	W.	Moderate.		Clear—cloudy.
	16	62	78	.50	.50	W.	do.		Clear—do.
	17	62	78	30 10	30.05	N.W.	do.	. 7	Partially cloudy—rain.
☾	18	63	80	.10	.13	S.W.	do.		Clear—do.
	19	67	86	.10	.10	S.W.	do.		Clear—do.
	20	73	83	.05	.00	S.W.	Brisk.		Cloudy—lightly do.
	21	72	80	29.90	29 85	S.W.	Moderate.	.30	Rain—cloudy.
	22	72	84	.80	.80	W.	do.		Partially cloudy—do.—do.
	23	72	85	.80	.83	W.	do.	.40	Drizzle—rain.
	24	70	84	.86	.86	W.	do.		Clear—do.
🌝	25	72	80	.80	.80	S.W.	do.	. 7	Cloudy—clear—rain.
	26	70	85	.65	.70	N.W.	do.		Clear—do.
	27	72	85	.80	.83	W.	do.		Clear—do.
	28	68	81	.83	.83	W.	do.		Cloudy—do.
	29	70	76	.83	.83	S.W.	do.	. 1	Cloudy—drizzle.
	30	68	84	.80	.80	S W.	do.		Cloudy—do.
	31	73	84	.80	75	S.W.	do.		Cloudy—do.
	Mean	66.58	80.64	29.82	29.81			1 22	

	Thermometer.		Barometer.	
Maximum height during the month.	86.	on 3d, 10th, 11th, 19th.	30.13	on 18th.
Minimum " "	58.	5th.	29.50	15th, 16th.
Mean	73.61.		29.815	

JOURNAL

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OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

DECEMBER, 1839.

Practical and Theoretical Mechanics and Chemistry.

Account of the performance of the Screw-Ship Archimedes.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir—Previously to my leaving London last September, I visited the screw ship Archimedes, and was very much gratified with her appearance as a ship, and with the compactness of her engines and screw propeller. The following account of her first voyage from London to Portsmouth is not without great interest to steam navigation.

Very respectfully, yours,
W. Strickland.

Philadelphia, November 21st, 1839.

The first voyage the Archimedes performed was to Sheerness, from thence to Margate and Ramsgate; she accomplished every thing that was required of her, in the most perfect manner. At Sheerness, Admiral Sir Robert Otway came on board, who took the helm and steered her for some time, and in a letter to Chas. Caldwell, Esq., dated Sheerness, May 12th, he expressed himself in the following terms.

"I steered her myself for some time, and I was much surprised and pleased at the quick manner in which she answered the helm, and I must also observe, that she moved quickly over the water, and at a fair rate. I think your having got rid of the paddle boxes, and the engines being placed so low down, are very great improvements, and must lead to the introduction of the screw into Her Majesty's service.

"I enclose a most gratifying report from an intelligent officer, who happened to be on board the Archimedes at the time, and went in her to London."

Report of Lieutenant Wright.

"In compliance with your desire respecting the observations I had an opportunity of making on board the Archimedes, on the passage from Sheerness to London, last Wednesday, I beg to state, that from what I saw, I consider the principle of propelling by the screw as perfectly established, the vessel having gone at one time, an exact mile in six minutes and a half, though under the disadvantage of the propeller being too large for the power of the engine, to give it the necessary rapidity of rotation. She steered admirably well, stopped, and backed with a readiness and facility equal to the steamers with paddles, and during the short time we were under sail and the vessel heeling over considerably, she behaved fully as well, and I could not detect the least motion in the vessel, caused by the propeller, similar to that of vessels with paddles; she went very smoothly through the water, leaving only an agitated stream on each side of her rudder, and so on in her wake.

"Upon the whole, I consider the invention will turn out to be one well adapted to combine both the sailing and steaming of vessels together. The propeller from its situation, two feet below the surface of the water, is completely protected from the range of shot, and being above the keel, could not be injured by touching the ground, and I believe it will be found perfectly practicable to ship and unship the propeller with great speed, by raising or lowering it down in a groove inside the vessel. The great number of advantages the invention offers, over the paddles, must, of course, be obvious to every one.

I must now notice the points that appeared to me objectionable. The first is, the very great vibration of the engine, caused by the cogged wheels, necessary to carry the power to the main rod of the propeller, but this objection, I believe, may be removed. The next is, that I should fear that the great length of overhanging stern required to make the requisite room for the propeller, might, in a heavy sea, and the vessel pitching much, cause her to be much strained abaft; but at the same time, I should hope that even this objection might be remedied."

Eminently successful in this our first experiment, the Archimedes was prepared to go to Portsmouth, upon the occasion of the launch of Her Majesty's ship, the Queen, of 120 guns.

She performed this voyage with equal success to the first, I may add in a most brilliant manner, under stress of severe weather, and head winds, for the most part of the voyage, accomplishing the distance from Sheerness to Portsmouth, in 21 hours, including the time occupied in taking up her station alongside the Victory. She there remained till the 19th of May, when she returned to London. During the time she was at Portsmouth, she was visited by all the great naval characters who were assembled to witness the launch of the Queen, and she was open to the inspection of nautical men of every description, and elicited from them expressions of unequivocal admiration.

I here add an extract from a letter of Admiral Flemming to Mr Tuffnell, dated, Portsmouth, May 19th.

"I was on board and went out of the harbour in her, so did Lord Dun donald, and several other naval men, who all think most favourably. The day of the launch, there was no one to attend, and next day, unfortunately, a court martial, which prevented two Captains going there.

"I think it a most useful invention, and capable of being turned to good account in war vessels; she made a great impression on all who saw her, and a most favourable one. In rivers it is invaluable, as it causes no swell to hurt boats. It is not affected by the inclining of the vessel under sail; the only drawback is from the constant friction."

These combined facts, and the opinions of such authorities appear distinctly to prove the problem solved respecting the powers of the screw in navigation, and its superiority over the paddle; nevertheless, the public will require still further evidences, and it is obviously our business to furnish them.

The above is extracted from a statement drawn up by Lord Western.

On the new Metal, Latanium. By James C. Booth and Campbell Morfit.

A notice of the discovery of this element having already appeared in one of our Scientific Journals, it occurred to us that an account of some of our experiments with it might present a subject of sufficient interest to the readers of the Institute Journal.

The name is derived from the Greek λαντανειν, to lie hid;* it is called in Swedish and German, Lantan, but in English Latanium, for the sake of euphony and in accordance with the generally received termination of the names of the elements. The ordinary method of obtaining cerium by precipitation with the bisulphate of potassa, threw down a bi-salt of Latanium at the same time, the latter constituting two-fifths of the whole saline mass. The method of separating the two depends on the ready solubility of oxide of latanium in dilute acid after ignition, a property lost by cerium under the same circumstances. From its nitric solution, it may be best thrown down as a white, crystaline carbonate, by carbonate of ammonia, and from this its other compounds may be formed.—The dry chloride heated with potassium was reduced to a gray metallic powder possessing a dark lead-color, and capable of being flattened together by pressing. It is slowly converted into oxide in the air, and in cold water into a hydrated oxide with the evolution of hydrogen. An effervescence takes place in hot water.

It has two isomeric states. The ordinary salts possess a faint reddish tinge, but when the yellowish red oxide is heated in hydrogen gas, it becomes white with a faint shade of green, and dissolves with more difficulty in acids, forming salts which possess a greenish hue.

With bisulphate of potassa it forms a slowly soluble salt, which, however, does not precipitate like the corresponding salt of cerium, unless the latter be also present in solution. Its atomic weight is lower than that adopted for the oxide of cerium.

The above notice is mainly extracted from Berzelius' letter to Poggendorf, published in Nos. 4 and 5 of Poggend. Annals for the present year. Our experiments were as follows.

Having prepared the sulphate of cerium and potassa by the ordinary methods from the mineral cerite, it was dissolved in a large quantity of boiling water, and the hydrated oxides of cerium and latanium precipitated by caustic potassa. These were dissolved in nitric acid after being thoroughly washed, evaporated to dryness, and heated in a platinum crucible until all the nitric acid was expelled. The oxides remained of a light reddish brown color, and were transferred to a glass containing nitric acid diluted with 60 to 80 times as much water. After digesting about two hours in a gentle warmth, the latanium was dissolved and oxide of cerium remained of a reddish-brown color. The solution treated with caustic potassa threw down the white hydrated oxide of latanium, much more bulky and gelatinous in appearance than alumina. It is exceedingly difficult, if not impossible, to wash it out thoroughly, for after edulcoration for several days, the liquid passing through the filter still gave indications of solid matter, and almost led to the belief that the oxide was slightly soluble in water.

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* From its concealment hitherto in the compounds of Cerium.

On redissolving hydrated oxide in nitric acid, evaporating to dryness, and heating to redness, the dry oxide remained of a brick-red color, differing therefore from the oxide of cerium by a lighter hue, and by containing less of a brownish shade. On treating this oxide as before with very dilute nitric acid, a small portion of oxide of cerium remained, proving that this mode of separating the two metals is not accurate, and that we must await farther experiments for the discovery of a more perfect method.

Carbonate of latanium, as thrown down by carbonate of soda, is a voluminous white precipitate, and, like the hydrated oxide, very difficult of edulcoration, for after obtaining the chloride from it, crystals of common salt were also visible. Agreeably to the observations of Mosander, therefore, the carbonate of ammonia is the best precipitant.

Sulphate of latanium is readily formed by the solution of the oxide, or carbonate, in dilute sulphuric acid, evaporation to a small bulk by heat and exposure to self-evaporation, while delicate needles of a flesh-red color collect in little groups on the bottom of the capsule.

The chloride is similarly formed by means of chlorohydric acid and evaporation. It forms a light yellowish green crystaline mass, in which no determinate form was observed.

The quantity of latanium in our possession was so small, amounting only to a few grains, that the operations were necessarily conducted slowly, and prevented our pursuing them quantitatively. Should we be enabled to obtain a larger amount, we may give more interesting results, without, however, trespassing on the field legitimately belonging to the discoverer.

Notice of the advances made in the Science of Mineralogy during the year 1837. From the Report of Berzelius to the Swedish Academy.

(Continued from page 301.)

*Schrötter** examined a mineral from Döllenberg, which he called Opalin-Allophane. It has no determinate texture, is light emerald-green passing into light brown, has a glassy lustre, white streak, is semi-transparent, has a sp. gr. =1.985—2.016, gives off water before the blow-pipe, fusing neither alone nor with soda, and consists of:

Silica,	11.95
Alumina,	46.30
Oxide of Iron,	2.95
Lime,	1.30
Sulphuric acid,	0.78
Oxide of Copper,	0.25
Water,	36.20
	99.73

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* Poggend. Annal. XLI, 380.

Its formula is $A^2 S Aq^4 + 2 A Aq$ or $A^4 S + 6 Aq$.

Glocker[*] gave a full description of Halloisite from Mechomitz, in Upper Silesia, together with an analysis of the same by *Oswald*, according to whom it consists of:

Silica, . . .	40.25
Alumina, . .	35.00
Water, . . .	24.25
Magnesia, . .	0.25

It contains a trace of manganese, and corresponds to the formula $A S^2 Aq^2 + A S^3 Aq^3$.

Beyrich[†] examined accurately the crystaline form of Phenakite, and confirmed the description of it as given by Norkenskjöld.

Brooke[‡] described a well formed crystal of Pyrosmalite from Nordmarken. It is a regular six-sided prism, with terminal planes, the edges of which are replaced by two planes, the upper forming an angle of 148° 30′, and the lower one of 129° 13′, with the terminal plane.

Von Holger[§] asserts that *Agal matholite* has such genuine characters of a magnesian silicate that they who analyzed it without finding magnesia, did not understand the method of separating this earth from Alumina. Among these inexperienced chemists we unexpectedly find Klaproth and Vauquelin, besides Lychnell, who gave the last analysis (Report, 1836). V. Holger who asserts that he analyzed a true Agalmatholite, and found it composed of:

Silica, . . .	61.0
Magnesia, . .	25.4
Lime, . . .	3.0
Alumina, . . .	5.0
Protoxide of Manganese, . .	0.9
" of Iron, . .	4.3
	99.7

This composition belongs to the Talcs. That Klaproth, Vauquelin and Lychnell knew how to distinguish magnesia from alumina might perhaps be assumed with more certainty than that V. Holger could discern a compact talc from agalmatholite. It is remarkable how nature often replaces soundness of judgment by a firm conviction of one's infallibility. * * *

Breithaupt gave the name of Perikline to one of the soda-felspars, from its diminished specific gravity and a slight variation in the angles. *Thaulow*[‖] analyzed it and found its composition to be:

Silica, . . .	69.00
Alumina, . .	19.43
Soda, . . .	11.47
Lime, . . .	0.20
	100.10

This gives the formula $N S^3 + 3 A S^3$ which is the same as that of Albite.

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[*] Poggend. Annal. XLII, 173.

[†] Poggend. Annal. XLI, 323.

[‡] L. & E. Phil. Mag. XI, 261.

[§] Zeitschrift für Physic E. v. Baumgartner, V. 1.

[‖] Poggend. Annal. XLII, 571.

G. Rose[*] examined it and found the angles varying from Albite, but referred the difference to striæ and curves on the surface of the former. There remained then the sp. gr., which with Albite is 2.61 to 2.63, and with Perikline is 2.437 to 2.457. But when it was pulverized it gave 2.637—2.647. The sp. gr. of powdered Albite was not determined. Here is another of Breithaupt's new species lost, and how many more will follow? I am far from undervaluing his minute investigation of the external characters of minerals, but like every superficial research, it is reprehensible to consider it as any thing more than a guide to examine whether such variations arise from real differences, and permit the establishment of new species.

Dufresnoy[†] described a mineral under the name of Gedrite which occurs as pebble near Gedre. It is clove-brown, crystaline, partly fibrous and partly foliated, scratches glass, but is scratched by quartz; sp. gr. 3.26. According to his analysis it contains:

Silica, . . .	38.811
Alumina, . .	9.309
Protoxide of Iron, . .	45.834
Magnesia, . .	4.130
Lime, . . .	0.666
Water, . . .	2.301

Which necessarily gives the formula

$$\left.\begin{matrix} mg \\ C \end{matrix}\right\} S^2+6\,f\,S+2\ A\ S,$$

and appears to belong to the varieties of Hypersthene.

The mineral described as Davidsonite (Report, 1838), was analyzed by Lampadius[‡], and found to contain a variety of emerald.

The species of Asbest from Sterzing, in Tyrol, long since known under the name of mountain-wood, was analyzed by *Thaulow*[§] who found its constituents to be:

Silica, . . .	55.505
Peroxide of Iron, .	19.442
Magnesia, . . .	14.500
Lime, . . .	0.100
Alumina, . . .	0.040
Water, . . .	10.260

This gives the formula $mg\ S^3\ Aq^3+F\ S^2\ Aq^2$. Thaulow gives the chemical formula $(Fe^2\ 0^3+3\ Si\ 0^3)+(3\ Mg\ 0+2\ Si\ 0^3)+5\ H^2\ 0$, but it is evident that a basic salt with a stronger base cannot be chemically combined with a neutral salt of a weaker base, and that the neutrality must be transferred to the combination of the stronger, which is applicable in this case.

Hausmann[||] described crystals of turmaline from Sonnenberg, near Andreasberg. They offer the first decisive example, in which surfaces of a flatter rhomb are found on that end of the crystal exhibiting electricity in cooling, and scalenohedral surfaces on the other end. The planes are matt on the former and shining on the latter.

Turner,[**] whose death, during the past year, science is called on to lament, examined the green particles, which communicate the same color to green sand. They consisted of:

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[*] Poggend. Annal. XLII, 575.

[†] Journal für Pract. Chemie. XI, 129.

[‡] Journal für Pract. Chemie. X, 249.

[§] Poggend. Annal. XLI, 635.

[||] Poggend. Annal. XLII, 580.

[**] L. & E. Phil. Mag. XL, 36.

Silica,	48.5
Protoxide of Iron,	22.0
Alumina,	17.0
Magnesia,	3.8
Water,	7.0
Potassa,	a trace
	98.3

They appear, therefore, to be fine parts of a kind of Chlorite.*

A mineral from the marble quarry Marmorskoi known as Chlorite-spar, to which G. Rose gave the name of Chloritoid, was analysed by Von Bonsdorf,† who found it to consist of:

Silica,	27.48
Magnesia,	4.29
Protoxide of Iron,	27.05
“ of Manganese,	0.30
Alumina,	35.57
Water,	6.95

From this Von Bonsdorf calculates the formula

$$\frac{f}{mg}\,S+A^2S+3\,Aq,$$

which varies from that derived from *Erdmann's* analysis (see Report 1837, p. 176.)

COMMITTEE ON MINERALOGY.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Imperfect Elasticity of Glass Threads used in Torsion Instruments. By W. H. GOODE, *Chemical Assistant in the Laboratory of the University of the city of New York.*

From the superior elasticity which glass enjoys over most substances, particularly the metals, threads of this material have replaced the metallic wires with which the needles of torsion instruments were at first suspended. The late Dr. Ritchie employed them in his improved torsion galvanometer, which emulates the torsion balance of Coulomb, for accuracy in measuring small forces. It is necessary, however, to the perfection of torsion instruments, that the elasticity of the thread of suspension, though a feeble, should be a constant force; and also that the thread itself should suffer no alteration of its conditions by the amount of force exerted upon it. Perfectly elastic substances only, fulfil these requirements; on all imperfectly elastic bodies torsion acts irregularly, and impresses a change upon them which prevents their return to their normal position, after it has been removed; such, for example, is the change effected in the conditions of metallic wires, filaments of silk, hair, &c., which, being imperfectly elastic, fail to return to zero when released from torsion.

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* The external resemblance of portions of the green sand of Europe to those of our states, and the similarity of composition, according to the analysis of Berthier and others, taken in connexion with the small amount of alumina and the greater proportion of potassa in our own, would seem to refute the opinion of Berzelius relative to their chloritic nature or origin. Nor does the opinion of Prof. Hitchcock appear to us better founded, that the constituents of green sand are not chemically combined, although we do not conceive them to be united according to the same atomic formula. *Com. Min.*

† G. Rose's tour to the Altai and the Caspian Sea, I, 252.

The impression has become general that threads of glass, of a certain degree of tenuity, unlike the substances already mentioned, are not permanently affected by force exerted on them; but are capable always of regaining their original position; their elasticity is therefore considered to be perfect,—and measures effected with instruments to which they are adjusted, rigidly accurate. Having observed that the needle of a galvanometer suspended by a glass thread did not return to zero, after the instrument had been employed in a series of observations, it became a subject of inquiry to ascertain the source of error. For this purpose, threads of different diameters were suspended, in a manner similar in all respects, to that of a torsion balance. Two small uprights were placed on opposite sides of the little glass needle, near its opposite ends, which served as obstacles to it when torsion was made, and prevented it from rotating along with the micrometer. On some point of the thread, another little glass needle, carrying an upright arm, was cemented. This arm served as an index for the thread, and marked its position on a scale pasted on the opposite side of the jar; it was observed through a small hole in a plate of metal, placed ten or fifteen inches distant;—an improved method of observing a vertical index introduced by Professor Draper, London and Edinburgh Journal of Science, for October, 1839.

The thread being freely suspended, its index and that of the micrometer at their respective zeros, a torsion of three revolutions of the micrometer was exerted on the thread for five minutes; when released from this force it did not resume its position at zero, but varied from it in the direction opposite to that in which the torsion had been made. If the micrometer be now kept at zero, it will be found that the thread partially recovers itself, after the lapse of several hours; the amount of error is consequently diminished, but it never returns accurately to its original position. If instead of releasing the thread by returning the micrometer to zero, the thread be released from the obstacles, the same result will be obtained; in consequence of the impetus it acquires in spinning round, this latter is probably the less accurate method of observation.

A variety of experiments were performed with different threads, to ascertain if the alteration of the zero bore any constant relation to the amount of torsion employed. If such were the case, a system of compensation could be adopted which would free instruments fitted with glass threads from error.

The result of the observations made with one thread are given, for convenience, in a tabular form; they are analogous to those obtained with others; and indicate that the amount of the alteration of the zero, for the same threads, for different degrees of torsion, bears no constant proportion to the amount of force employed.

TABLE I.

	No. of degrees of Torsion.	Error of Zero.	Duration of Torsion.	Thermometer.
1	360°	2°	5′	70°
2	720°	10°	5′	70°
3	1080°	13°	5′	70°
4	1440°	20°	5′	70°

The thermometer was carefully noted in these experiments, lest the temperature of the room should vary during the prosecution of them; for it is not known what influence changes of temperature may exert on the elasticity of glass. After a lapse of twelve hours the thread had not returned to zero: another zero being assumed the following table of errors was obtained.

TABLE II.

	No. of degrees of Torsion.	Error.	Duration of Torsion.	Thermometer.
1	360°	2°	5′	70°
2	360°	3°	5′	70°
3	360°	3°	5′	70°
4	720°	6°	5′	70°
5	1080°	9°	5′	70°
6	1440°	12°	5′	70°

The thread was now left freely suspended for two hours; another needle and index were then adjusted to it, parallel to the first, but at twice the distance of the first from the micrometer: two points of the thread could now be observed and the effect of torsion on a double length noted. Up to 1080° the error of its two indexes was the same in amount; for that degree of torsion, the farther index varied more from its zero than the nearer, and consequently required the micrometer to pass through a greater space to restore it to that point. For a torsion of 1440° the error of the more distant index from the micrometer exceeded that of the nearer, three degrees. The tabular results are as follows:

TABLE III.

	No. of degrees of Torsion.	Error.	Duration of Torsion.	Thermometer.
1	360°	3°	5′	70°
2	720°	6°	5′	70°
3	1080°	6°	5′	70°
4	1440°	*	5′	70°

* Upper Index 5°. Lower one 8°.

The result indicated in the last experiment of the preceding table, has been observed to take place repeatedly when high degrees of torsion have been employed and continued for a long period. It is probably due to slight inequalities in the diameter of the threads and to their being differently annealed in different portions of their length; force exerted on them would, under such circumstances, produce more decided effects on some portions than on others, and the effort made by the thread to recover itself would also occasion in different parts of it, different degrees of error.

An inspection of these tables will show that the whole amount of error, for each series of observations, is decreasing; in the first it amounted to 20°, in the second to 12°, in the third to 6°. It would therefore appear that a certain amount of torsion could be exerted on the thread for a certain period, for which it would afford no error of the zero. One thread which has been operated with, exhibited this effect of force exerted on it, in a very marked manner; for a torsion of two revolutions of the micrometer, its zero altered 10°, but for four revolutions there was no alteration. It was broken in making another observation.

For degrees of torsion less than that at which this effect takes place, the error of the zero will continue to exist; as it is observed, in the two last tables that for one and two revolutions of the micrometer, the error is nearly constant.

It has been shown that a force amounting to one revolution of the micrometer exerted for five minutes, produced a permanent deflectionof the zero of the thread, two degrees. An attempt was made to ascertain the influence of smaller degrees of force on the thread, exerted for a longer period. A torsion of 270° produced, in five minutes, a permanent deviation of the zero of 1¾°; 180° of torsion in the same period occasioned no error. A torsion of 90° continued for half an hour, produced an alteration of 2°; for 45° of torsion continued one and a half hours, it altered 3°. The permanent alteration of the zero of a glass thread appears to be occasioned, either by a large amount of force exerted upon it, or by smaller forces acting for a comparatively long period. The amount of this alteration is modified by a variety of circumstances; the diameter of the thread—the uniformity with which it cooled in being drawn—the amount of force to which it has been subjected, and its duration—combine in producing this effect; which, influenced by so many causes, must necessarily be variable in amount,

It is not probable that any two threads will afford the same numerical value of their respective errors of zero, for the same force exerted on them. We cannot be certain that they are in precisely the same condition—that they are identical in composition, or that they are equally well annealed. Both, however, will fail to return to zero after a certain amount of torsion has been exerted on them, by a quantity which diminishes for every series of observations; and which for a certain amount of torsion, becomes nothing.

The effect of this error of the zero on instruments constructed for the purpose of measuring small forces by torsion, is to cause the deviations of the needle, when the thread is newly suspended to be less than they ought to be, and less than they ever are afterwards; in each succeeding observation the force acting on the needle has to overcome not only the forces which keep it in equilibrio, but that also which deflects the thread from its zero; as this latter increases with the increase of torsion and with the time it occupies, the last deflections of the needle are much less than the first of the same series.

This kind of error will be found in every series of experiments, though it will vary in amount; but it will still be sufficient if not corrected for, to vitiate results requiring to be obtained accurately. In using torsion instruments, after each observation, the error of the zero ought to be ascertained and the due correction applied. But where it can be done, it is advisable first to ascertain the amount of torsion necessary in five minutes to cause an alteration of the zero; and then to ascertain the period of time which that amount of torsion intended to be employed requires to produce the same effect, and not transcend these limits, by employing a greater amount of force on the thread, or using the instrument continuously for a longer time than it will afford correct measures.

Determination of the Longitude of Dover, Tuscarawas county, Ohio, from the Astronomical Observations of Mr. J. Blickenderfer, Jr. *By* Sears C. Walker.

Philadelphia, November 27th, 1839.

To the Committee on Publications.

Gentlemen,—I have compared Mr. Blickenderfer's Observations, published in the last number of the Journal, with corresponding observations made in the Atlantic Cities, and find for the longitude of his place of Observation at Dover, Tuscarawas County, Ohio, west of Greenwich, the following results :

From the Annular Eclipse of the Sun, Sept. 18th, 1838, as reduced by E. O. Kendall, by comparison with

Philadelphia,	Begin.	5h 25 53.92	
	F. R.	45.72	
	R. R.	58.44	
	End.	59.13	
	mean		5h 25m 54.30s
Princeton,	Begin.	48.02	
	F. R.	40.76	
	End.	67.75	
	mean with double weight to end.		56.07
Washington,	Begin.	55.46	
	F. R.	48.72	
	R. R.	62.87	
	End.	63.49	
	mean		57.64
Haverford,	Begin.	55.68	
	F. R.	46.46	
	R. R.	60.89	
	End.	56.72	
	mean		54.94
Southwick,	Begin.	51.79	
	End.	55.29	
	mean		53.54
	mean result by this Eclipse,		5 25 55.30

From the Immersion of η Pleiadum, Dec. 27th, 1838, as reduced by myself by comparison with

Philadelphia,	Im.	5 25 55.97	
Princeton,	Im.	55.85	
Southwick,	Im.	54.00	
	mean		5 25 55.27

From the Immersion of f, Pleiadum, the same evening, by comparison with

Philadelphia,	Im.	5 25 55.99	
Princeton,	Im.	59.24	
Boston,	Im.	56.30	
Breslaw,	Im.	61.09	
	mean		5 25 58.15
	mean by η and *f* Pleiadum,		5 25 56.71
	result by the Eclipse,		55.30
	longitude of Dover,		5 25 56.00

The latitude of Dover as given by Mr. Blickenderfer, is 40° 30′ 52.″ The longitudes of the places of comparison on which these results rest are, from Greenwich,

	h.	*m.*	*s.*	
Philadelphia State House, . .	5	0	39.	West.
Princeton, Prof. Alexander's House,	4	58	39.	"
Washington Capitol, ...	5	8	6.	"
Haverford School, Pa.	5	1	15.	"
Southwick, Mass.	4	51	16.	"
Breslaw Observatory, Germany, .	1	8	10.4	East.

By inspection of Mr. Tanner's Map, for 1837, it appears that the longitude of Dover is 17*m.* 54.2*s.* west of the Capitol, which gives its longitude 5*h.* 26*m.* 0.2*s.*, or 4 seconds of time, or one minute on the parallel of 40.°5, or finally about three fourths of a mile too far west. On reducing the moon-culminations observed in 1835, by Capt. Talcott, late of the U. S. Engineers, it appeared, that in the same map, Turtle Island, Lake Erie, latitude 41° 45′4″, had been placed in longitude 5*h.* 33*m.* 26.2*s.*, which is 5.6s too far east, its true longitude being 5*h.* 33*m.* 31.8*s.* Also, South Bend, or the southernmost point of Lake Michigan, latitude 41° 37′ 6″, was placed on this map in longitude 5*h.* 48*m.* 57.1s., which is 21.4s. too far east, its true longitude being 5*h.* 49*m.* 18.6*s.* In making this comparison I have corrected this map for the error in the assumed longitude of the prime meridian, that of the Capitol, which it is well known, is set down about 24 seconds in time, or 6 minutes on a parallel of 38°.9, or finally about 4½ miles, too far east. The errors of Mr. Tanner's map are certainly much less than would have been expected; when we consider the smallness of the number of astronomical observations which have served for its basis. This poverty of data for perfecting our maps can only be removed by such voluntary contributions as those of Mr. Blickenderfer. It is much to be wished that Geographical Engineers, most of whom are possessed of instruments adequate for the purpose, would follow the example of Mr. Blickenderfer, and forward their observations for publication. It often happens, that more depends upon the observer than the instruments. In the present instance, the results of the 18th September, and 27th December, present as close a coincidence as could have been expected in a fixed observatory. SEARS C. WALKER.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1838,

With Remarks and Exemplifications by the Editor.

1. For an improvement in the *Machine for Pressing Bricks from Dry Clay;* Benjamin H. Brown, city of Washington, December 8.

This machine is, in its general construction, similar to that patented for the same purpose by Mr. Nathan Sawyer; but there are certain points of difference, which, it is the intention of the present patentee to secure. The moulds are to be filled from a hopper which contains the pulverized clay; said hopper is made to slide back and forth, and passes in over the mould after the pressing piston has been raised, and the pressed brick removed, which is effected by the advance of the hopper. Instead of the provision adopted by Mr. Sawyer for having a sufficient quantity of clay at each end of the mould to make the angles of the brick perfect, there are two small condensing pieces which condense the clay at the two ends of the mould, and are withdrawn to allow the space made by them to be refilled, before the descent of the piston. The claims are to "the manner of constructing the hopper for filling the mould, by which construction it is made to tilt as it advances, still keeping its back edge in a position to receive the clay from the inclined plane, whilst the mould is filled through the opening, under the foot [of the hopper] and the pressed brick pushed off by it. Also, the provision for condensing the clay in each end of the mould, preparatory to the pressing of the brick; that is to say by means of the two condensers as described."

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2. For a machine for *Punching and forming the eyes of Axes, Hatchets, &c.;* Elisha K. Root, Collinsville, Hartford county, Connecticut, December 10.

This machine is, from its nature, one of too much complexity to admit of a clear description without the drawing; its parts, however, appear to be as simple as is compatible with the proper performance of its office. The patentee states his object to be, "to cut, punch, and form in solid iron, at a single heat, or with great dispatch and accuracy, the eyes of axes and hatchets of various forms; whereby an important saving is made in the iron, coal, and labour, and the axe and hatchet eyes are rendered more perfect and uniform."

"The peculiar feature of my invention consists in using two punches, or chisels, at the same time, to punch the same axe or hatchet eye, instead of one, and in punching by the force of pressure instead of by the force of blows struck by hammers, weights, or the like. The combined action of the two punches compresses the heated iron less, and divides it more exactly and equally into opposite cheeks than is practicable with one punch, and leaves a better shaped eye to finish on the eye pin."

"What I claim as my invention in the machine herein described, is the arrangement whereby a pair of punches, or chisels, are made to operate simultaneously on the opposite sides of the iron, so as to meet each other in the body thereof; and this I claim, whether the punches, or chisels, be driven by means of cams, levers, and punching slides, in the manner described, or in any other way producing the same effect by analogous means. I claim, also, in combination with the punches, or chisels, operated on as aforesaid, the jaws, or champs, for holding the iron centrally. I likewise claim, in combination with such punches, or chisels, the stands, or projections, at the front of the punching slides, constructed and operating substantially as described. Not intending, by these claims, to confine myself to the precise mode of construction herein set forth, nor to the using of all the parts described, as some of them may be omitted, whilst the main feature of my invention is retained; namely, the punching of the eyes of axes, hatchets, &c., from the two sides of the iron simultaneously, thus dividing the iron more equally, and more uniformly, and making better eyes than can be formed by a single punch, or chisel, or by the force of blows applied to punches, or chisels, in the ordinary way."

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3. For an improvement in the *Manufacture of Carpeting and Rugs;* John Humphries, city of New York, December 10.

The claim made is to "the attaching to the back or bottom of carpeting and rugs, known and designated by the names of brussels, brussels back, wilton, royal wilton, saxony, embossed imperial, and imperial, made with any material whatever, an additional ply, rib, knit substance, or body of material of warp and weft, as described." The additional ply is represented as a very stout thread, or cord, which is laid transversely upon the bottom of the carpet, and is secured to it by means of threads passing alternately over and under the respective strands in the weaving; the additional ply stretches along in straight lines, not being in any degree drawn into the body of the carpet.

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4. For an improved *Machine for dressing Mill Stones;* Zebulon Cheesborough, Alden, Erie county, New York, December 10.

A chisel, or chisels, suitable for facing, dressing, or furrowing mill stones, is affixed to the end of a hinged, or jointed, arm, which may be raised up and down by hand so as to strike upon the stone. The hinge of said arm is made to slide back and forth upon a round steel rod, constituting the joint pin, allowing the chisel to be carried correctly along the line of a furrow. The whole is attached to a bed, or carriage frame, which is to be laid upon the stone, and kept in place by weights; there are proper provisions made for adjusting the length of the arm, and other parts. The claim is to "the combination of the chisel stock, with the axis-rod and carriage, as described."

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5. For an improved *Sofa Bedstead;* Nicholas McGraw, city of New York, December 10.

Sofa bedsteads with sliding fronts, and falling backs, have been variously constructed, and all that remains to be claimed is the particular devices adopted by their makers, so far as the same may appear to be new; such are the claims in the present instance; the arrangements are made with skill and neatness, and the model in the office represents an elegant article of furniture.

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6. For a *Corn Plough;* John Hernly, East Hampfield, Lancaster county, Pennsylvania, December 10.

The claim is to "the peculiar manner of constructing, affixing, and connecting the mould boards, so as to admit of their being shifted and turned so as to regulate the distance apart, and the breadth of the furrows."

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7. For an improvement in the mode of *Smelting Iron ores;* Joseph Richards, city of Philadelphia, December 10. (See Specification.)

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8. For *Heating the air for the hot blast in furnaces;* Joseph Jones, York, York county, Pennsylvania, December 10.

This patent is taken first, for the particular manner in which the pipes for heating the air are arranged in the heating oven at the tunnel head; the object being to increase the heating surface by the particular arrangement of the pipes, which arrangement is claimed. The second claim is to the employment of the hot air conducting pipe, to open and close a damper in the chimney of the oven, which, operating upon a self regulating principle, closes the damper by its expansion, and prevents the passing of the flame from the furnace stack through the oven. The third improvement is in the manner of constructing a water tuyere, by casting it in two parts, so that the part exposed to the fire may be renewed at pleasure.

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9. For an improvement in the *Boilers of Locomotive and other Steam Engines;* Jacob Perkins, now residing in the city of London, December 15.

In this boiler there is to be a large number of tubes, which pass through its bottom, and extend down into the fire chamber, and up into the water of the boiler; these tubes are each to contain a quantity of water or other fluid, (water being preferred,) and they are to be hermetically sealed, so that the water contained in them cannot escape, but will be converted into surcharged steam, the heat from which is to be conveyed therefrom to the water within the boiler. The quantity of water in the tubes is to vary with the density required of the steam that is to be produced. "For steam and other boilers under atmospheric pressure, the quantity of water to be applied in each tube is to be about the one thousand eight hundredth part of the capacity of the tubes; for a pressure of two atmospheres, two one thousand eight hundredth parts, and so on for greater or less degrees of pressure, by which means the tubes will, when the boiler is at work, be pervaded with steam, and any additional heat which is applied, will rise quickly to the upper parts of the tubes, and be given off to the surrounding water." "What I claim as my invention is the combining a series of closed tubes, having quantities of water therein, which, in being heated, is expanded, and becomes the means of conducting any additional heat, which may be given off by the furnace to the water in the boiler, according to the principles above described."

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10. For apparatus for *Evaporating the extract of bark and other liquids*; George W. Klein, Boston, Massachusetts, December 15.

There is to be a vertical pipe, or tube, into which steam is to be admitted at its upper, and is to pass down to its lower, end, where the water produced by condensation is to be carried off by a discharge pipe, furnished with a safety valve. The vertical steam tube is to be surrounded by a spiral trough, descending like the thread of a screw, from the top to the bottom, and the extract to be evaporated, is to be made to run down this trough, of which the steam tube constitutes one side. The whole is to be inclosed within a wooden box, or case.

Claim. "I claim as my invention and discovery this mode of evaporating liquids and infusions of bark, or other astringent matter used in the manufacture of leather. I claim, also, an evaporating apparatus constructed and operating in the manner, and on the principles, I have set forth, for said purposes."

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11. For *Locks for Trunks, Chests, &c.;* Henry C. Jones, Newark, New Jersey, December 15.

This lock bears a near resemblance to locks which we have seen of German manufacture; there are to be two spring bolts, which, when the trunk, &c., is shut, catch upon, and embrace, the piece which is attached to the lid, and which enters the lock in the manner of the ordinary staple in desk locks.

The key is made to act upon levers, which open the two spring bolts simultaneously. The claim is to "the employment of two levers, which act upon the jaws of the catches in opening the lock, in the manner described." We do not, in this lock, perceive any thing calculated to attain the object of special security, but think that it might be picked with considerable facility.

12. For an improved *Spark Arrester;* Benjamin Briscoe, city of Detroit, Michigan, December 15. (See Specification, at p. 236.)

13. For a *Spark Extinguisher;* Samuel Leonard, Bridgewater, Plymouth county, Massachusetts, December 15.

The upper end of the smoke flue is to be surrounded by a trough containing water, and above the opening of said flue there is to be a revolving bell-formed, or conical, cap, having its open mouth downwards, and of such diameter beyond that of the flue, as to double the capacity for the draught. On the inside of this cap there are to be wings, or vanes, which by their revolution are to throw the sparks down into the water, whilst they are intended at the same time to increase the draught.

Claim. "What I claim as my invention, and desire to secure by letters patent, is a conical cap, or bell, with wings, or fans, revolving over the top of the funnels of locomotives and steam-boats, and other funnels, to cause a sufficient draught, and extinguish the sparks proceeding from them, by throwing them into water; and also a vessel surrounding the funnel to contain water to extinguish the sparks, and to heat the water, by which the engine may be supplied, in a manner substantially the same with that herein fully set forth."

This is not the first contrivance made for the purpose of throwing the sparks down into a vessel of water, and the patent is not granted for this object, but for the particular manner of carrying on this and the other operations described in the specification. We have not received any information respecting the practical operation of this apparatus, but as the efforts are still continued to find the means of extinguishing the sparks from locomotive engines without injury to the draught, we apprehend that it has not been satisfactory.

14. For a machine for *Cleaning Grain;* George A. Johnson, Johnsonburg, Genessee county, New York, December 15.

The grain is to be let into a horizontal metallic cylinder, roughened on its interior, by punching from the outside. Within the cylinder there is a revolving shaft carrying arms on a vane, by which the grain is thrown forcibly against its interior, and is thus acted upon from the point of admission at the upper part at one end, to that of escape at the lower part of the other.

Claim. "What I claim as my invention in the above described machine, and which I desire to secure by letters patent, is the manner in which I construct the revolving apparatus within the cylinder, consisting of the open head with the vanes attached thereto, and the arms or wings in combination with each other, operating in the manner and for the purpose herein set forth."

15. For a machine for *Doubling and twisting Silk;* Jonathan Dennis, Jr., Portsmouth, Newport county, Rhode Island, December 28.

"The nature of my invention consists in spinning and twisting the silk from the cocoons, at the same time, upon one machine, that is so constructed that when part of the spindles are spinning, the others are doubling and twisting that which has already been spun;" the particular construction of this machine we shall not take time to point out, but merely add the claims, which are to "the combination of the flyers and spindles with the guides and hands of pointed wires, and the wheel (to which friction is applied,) over which the silk passes in doubling and twisting, in combination with the macerating cup, and with the flyer and spindle as described."

"The hands of pointed wires," mentioned above, are to prevent the rising of the tangled cocoons from the water.

16. For improvements in the machine for *Reeling Silk from Cocoons;* Jonathan Dennis, Jr., Portsmouth, Newport county, Rhode Island, December 28.

It will be seen by the subjoined claims, that the improvements which are the subject of this patent do not essentially alter the construction of the reel. They are, "1st. The hand of pointed wires or fingers to prevent the cocoons from being drawn so near to the guide as to allow the tangled fibres to be twisted in with the others and break the threads of silk; and, 2nd. The fluted ends of the twisting tubes with the guides and hands, as described."

The fluted tubes above mentioned, have the silk passing through them on its way to the reels, and these tubes being made to revolve rapidly, unite the fibres in their passage, and enable the tender of the machine to apply new fibres with facility.

17. For apparatus for *Extinguishing sparks and arresting cinders in the chimneys of Locomotives;* John Finlay, city of Baltimore, December 28.

This apparatus is similar in principle to, but different in arrangement from that described at No. 13, of this list. A wheel, like a ventilator, is placed near to the rear of the smoke box, and occupies the part leading from it to the chimney. This wheel is fixed upon a horizontal axis, and the edges of its vanes are to dip into a trough of water, which, by the rapid revolution of the wheel is to be thrown into spray, which is to produce the effect of extinguishing and arresting the sparks. The shaft projects through the back of the smoke box, and is driven by any suitable means.

Claim. "Now, what I claim as my improvement, and which I desire to secure by letters patent, consists in the use and application of a ventilating or a fan wheel, revolving through the water contained in a water case, thereby extinguishing and arresting the upward tendency or escape of sparks and cinders—they being thrown downwards into the water case, and the smoke only escaping through the chimney, or stack. The whole constructed substantially in the manner herein described, and represented in the accompanying drawings."

18. For improvements in *Flyers and Spindles for spinning and twisting Cotton, &c.*; John Howarth, and Nathan F. Jones, Andover, Essex county, Massachusetts, December 28.

The claims under this patent are to "the supporting the top of the spindle during its vibrations up and down in an elongated tube, whether the spindle be provided with a roller at the end fitting into the tube, or passes through a collar firmly fixed in the inside of the tube; the manner of applying the friction to retard the spindle; and the manner of retarding the spindle, spool, or bobbin, by a rectangular piece of metal or other material attached to the same, and operating against the atmosphere when in motion, the resistance of which creates a uniformity in the retardation of the same."

19. For an improved *Lantern for Steamboats*; John M. Read, Louisville, Jefferson county, Kentucky, December 28.

The lantern which is the subject of this patent has but little, if any thing, of novelty in its construction, as will be seen by the claim, which is to the "covering the front of the lantern with a hollow frustum of a cone or pyramid, in order to obscure the light in every direction except directly in front." Now this tube is so much like that used in the magic, and some other lanterns, as, apparently, to deprive it of every feature of novelty, should it not be found that a device so obvious in its character had been otherwise applied, of which there can be but little room to doubt.

20. For an improved *Brick Press;* Stephen Ustick, city of Philadelphia, December 28.

The patentee says, "I construct a shaft which is to be permanently fixed in a vertical position, and of sufficient strength to sustain all the working parts of the machine. Attached firmly to this shaft are two segments of cylinders which I denominate cam wheels, as, although they are in general stationary, they are intended to perform the office of cams, in a manner to be presently described. The upper and lower surfaces of these wheels at their peripheries, are so formed as, by elevations and depressions upon which friction wheels are to roll, to raise and depress the pistons, or followers, by which the pressing is to be effected, and to give to the pulverized clay which is deposited in the moulds, the pressure necessary to consolidate the earth. The stationary part of the machine, above named, is to be surrounded by a polylateral frame work which is to be made to revolve round the centre shaft, and is to have on each of its sides an apparatus consisting of a brick mould, or set of moulds, the pistons, or followers, by which the pressing is to be effected, together with such accessory parts as are necessary to complete the operation. The moulds in which the pressing is to be effected are open both above and below, there being two followers to each mould, one of which is made to rise as the other descends, so as to exert an equal pressure both below and above. The lower pistons constitute the effective bottom of the mould when it is being charged with the pulverized clay, and after co-operating with the upper pistons in pressing the brick, they are made to operate as lifters, rising to the upper surface of the mould, and presenting the brick, ready for removal, as the upper piston is withdrawn."

The patentee then describes his press by references to the drawings, and concludes with the following claims.

"What I claim as my invention is the manner in which I have combined and arranged the respective parts of my machine to produce the effect, as set forth; that is to say, I claim to be the inventor of a polylateral machine, furnished on each side with two vertical slides carrying pistons, or followers, for pressing both sides of the bricks simultaneously. Said frames being operated upon by circular cam wheels, either by the revolution of the outer frame, or of the shaft and cam wheels, the whole constructed and operating substantially as herein described. It is to be understood, also, that, although I generally make my machines polylateral, a single press may be made on the same principle, and is therefore included as of my invention."

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21. For an improved machine for *Making Iron Sockets*; Leonard Morse, and Harvey Pettee, Foxborough, Norfolk county, Massachusetts, December 28.

After describing the apparatus used by him, the patentee says, that "by substituting dies, triplets, and mandrels, of different forms and sizes, this arrangement may be employed for making sockets of any required form or proportions, from the thicker, stouter, and heavier, to the thinnest, lightest, and most delicate, according to the uses to which they are to be applied." Those shown in the drawing are such as might be attached to hoes, or to similar articles. The machine consists mainly of a hammer, operating as a trip hammer, its face being properly formed to strike upon the socket, the anvil forming the lower half of the die, and the socket being held upon a mandrel. The claim is to "the combination of the mandrel with the dies, and with the trip or tilt hammer, for the purpose, and in the manner, herein set forth."

There certainly is but little of novelty in such a machine, as the formation of various articles by analogous means is a thing well known; we think this case one of those, and they are numerous, in which the patent was granted upon a doubt of the propriety of refusing it, but without a clear conviction that the thing which it is desired to secure is substantially new.

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22. For an apparatus for *Condensing Steam and heating Air;* Asahel Collins, Ulster Village, Ulster county, New York, December 31.

This patent is taken for an apparatus for condensing steam by means of atmospheric air, and of applying the air after being heated, to the purpose of feeding the fire. There is a double drum, or case, divided into two compartments by a diaphragm, or partition; a shaft passes through the centre of this double drum, and carries two sets of vanes, one in each compartment of the drum. Into one of these compartments steam is to be admitted for the purpose of being condensed, and into the other atmospheric air; both the steam and air are to be forced out by the fans through a tangential pipe, within which, by their commingling, the steam is to be condensed and the air heated; from this pipe the air and water pass into a common receptacle, from which the water is to be conducted by one tube to supply the boiler, and the air through another tube to the furnace, to keep up the combustion.

The condensing by atmospheric air is not claimed, but the claim is to "the condensing of steam by atmospheric air by means of a revolving fan, and the heated air thus produced used as a supporter of combustion; and the application of the mercurial gauge as a regulator of combustion; these severally produced by the manner before described, or in any other mode or manner substantially the same."

The mercurial gauge, mentioned in the claim, is intended to operate so as to act upon the ash pit door, or upon a valve, to regulate the heat, but the particular method of doing this is not described, or represented in the drawings.

The whole arrangement, taken in connexion with the description, appears to be crude and undigested, and does not offer any thing likely to be of practical utility; and we are well assured that it would not, in its present form, have been made the subject of a patent, had it been essayed practically before making the application for one.

23. For an improvement in the *Platform Balance;* Robert L. McCollum, city of Rochester, New York, December 31.

The modifications of the platform balance which have been made the subjects of patents are numerous; the present is taken for the particular manner of making the suspension, the claims being to "the resting of the feet of the platform upon the tops of rings suspended upon edges, and moving with perfect freedom upon them, so that the ring will always adjust itself in such a manner that the bearing of the platform shall be directly over the edge; and a similar adjustment of the other bearing points of the machinery of the balance, all as described."

24. For a *Machine for throwing Balls, Shot, &c.,* Robert McCarty, city of New York, December 31.

This machine is described as a metallic, cylindrical case, about one and a fourth inch deep, and three feet in diameter, in its interior. It is to be placed, either horizontally or vertically, on a suitable stand, which will admit of its direction being changed. A hollow shaft carries a revolving arm, or arms, within this case, and the balls are to be dropped in through a funnel, or hopper, in the centre, whence they are carried round spirally by the revolving arms, and are delivered at the periphery of the drum through a tube intended to give them a proper direction. The claims made, are to "the throwing of balls, shot, &c., by the combined action of centrifugal and projectile forces, as set forth, without reference to the particular form of the propelling arms, or face plate, by which the same are projected."

The arms are, of course, to be made to revolve with great velocity, as the velocity of the ball must be determined by that of the end of the arm. We are decidedly of opinion, that this machine will utterly disappoint the sanguine anticipations of its projector and of many others, who, upon witnessing the partial trials made with it, have deemed it a very important invention, and have entertained an idea that a continued stream of balls may be thrown by it with the utmost facility. It belongs, however, only to those who are incapable of applying the proper analysis to arrive at such a conclusion. The throwing by centrifugal force, like the throwing by any other force, will require the application of all the power necessary to give the proper momentum to the masses of matter to be thrown, and may be made the subject of direct calculation; and we are assured that such calculation would result in a direct proof of the inadequacy of this apparatus, under any conditions which could be practically applied. What is intended by "the combined action of centrifugal and projectile forces," as applied to this machine, we do not understand.

Were there no radical objection of this kind, we think that it would still be very difficult to point out the situation in which such a machine could be advantageously employed; in our own country it would, most certainly, be impossible so to do.

25. For a Machine for *Cleaning Cotton;* Jacob Idler, city of Philadelphia, December 31.

The patentee calls this machine a *repeating cotton cleaner*, and the sub-

joined claim will afford a sufficiently distinct idea o
and mode of operation.

"The invention claimed and desired to be secured by letters patent, consists in the before described combination of two, or more, transverse parallel cylinders of bill hook teeth, made from separate plates of metal, each containing six teeth, more or less, working in spaces between the teeth of the several cylinders, with longitudinal, parallel, concave bars, armed with triangular, or other, teeth, placed under the first and second cylinders, between which the bill hook teeth work; and a concave of wire net-work, and transverse rows of inclined teeth and perpendicular brushes, through which the bill hook teeth also work; and a curved finger grating in the bottom of the hopper, fastened to a hinged frame, raised or lowered as required by a lever, through which finger grating the teeth of the first cylinder work, in the manner described, for separating the trashy particles from cotton in the seed, preparatory to the ginning operation."

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26. For improvements in making *Weavers' Harness*; John Thorp, and William G. Angell, Providence, Rhode Island, December 31.

The claim will afford a sufficiently clear general idea of the improvement believed to have been made; it is as follows: "What we claim as our invention, and desire to secure by letters patent, is the addition of one or more eyes to each and every headdle, over and above the single eye, forming two, or more, tiers of eyes through each leaf of the harness, and the flattening of the knots for the purpose herein described, and the manner in which we fasten the twine, or headdles, to the back bands of the harness, as above described."

The flattening of tne knots, it is said, may be effected in various ways, but its intention is, "that the threads of the warp may pass and repass them with more ease and less obstruction than they can when the knots are left in their natural shape." The increased number of eyes is intended "to make the harness more durable than the single eyed harness, it being the eyes that wear out before the other parts of the harness are injured by wear." The several webs are to be drawn first into one row, and next into another row of these eyes, to insure equal wear. Instructions are given how to proceed in making such harness.

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27. For *Drop Doors or partitions for rooms;* George Kilbrun, Walpole, Cheshire county, New Hampshire, December 31.

Partitions which may be made of panel works, or of light laths affixed together lattice-wise, and plastered over, are to slide within grooves in pilasters, or other suitable contrivances, and are to be raised by means of racks and pinions; the particular devices which may be thus employed are described and represented; the claims made, are to "the arrangement of the rising partitions, with the racks and pinions on the shafts to operate together, substantially as described. The constructing the rising partitions of laths or strips of wood laid on each other, and secured together and plastered, in the manner explained. The mode of finishing or completing the pilasters when the partition is raised, by small hinged portions of the same; also, the mode of finishing the soffit of the entablature by wedged strips."

There is certainly but little of invention in the proposed plan, most of the contrivances being of a very obvious character, and such as most workmen would resort to in the ordinary prosecution of their business, without entors. The raising of the partitions, or doors, by ions may, possibly, not have been before adopted, but the same device has been used for analogous purposes a thousand times.

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28. For an improved *Water Wheel*; William Hatfield, Zanesville, Ohio, December 31.

This is said to be an improvement on Parker's Water Wheel, which was patented about ten years ago. It is one of the kind denominated the reaction and percussion wheel, and "the invention claimed, consists in the peculiar form of the buckets, and the double spiral scroll placed between them for directing the water, in the manner described," which form and manner, we believe, will make but little, or no, difference in its action, and we shall not, therefore, stop to explain them, as we should have to tell a long tale, which, after all, would be somewhat obscure without an inspection of the model, or drawings.

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29. For *Managing the draught of Forges, Furnaces, &c.*, Asahel Collins, Ulster Village, Ulster county, New York, December 31.

The claim made under this patent, is to "the forcing of any required portion of the air, which has been exhausted, through suitable tubes or pipes, so as to supply heated air to the fire, in conjunction with such portions of fresh air as it may be found necessary to supply, the same being effected substantially in the manner set forth." The plan consists in making an inclosed ash pit, and in placing in the flue a fan wheel, which is to be made to revolve, so as to exhaust the air from the fire; a portion of this air is to be forced back into the inclosed ash pit, and there must, of course, be means adopted for admitting a fresh portion of air to keep up the combustion; the way in which this is to be done is not pointed out, but it was probably deemed sufficiently obvious.

A very similar device is noticed in Vol. XVIII, p. 320, of this journal, as patented by Mr. N. Lockling, and several others have been mentioned since the grant of Mr. Collin's patent, as having been previously known and used; we are not, however, prepared to say that they are precisely the same, not having had the time, or the means, for ascertaining this fact.

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30. For an improvement in *Water Wheels;* Thomas N. and Joseph N. Whitcomb, Grafton, Windham county, Vermont, December 31.

The claim is, to "the giving to the curb the form of the frustum of an inverted cone, and adapting the buckets thereto." There is a vertical shaft, which, at its lower end, has buckets placed spirally around it, these buckets are contained in a curb of the form mentioned, their edges nearly touching its interior; this conical form of the buckets and curb the patentees imagine will greatly increase the power of the wheel.

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31. For an improved apparatus for *Evaporating Saccharine and other liquids;* Samuel F. Harrison, city of Baltimore, December 31.

This apparatus consists of a number of boxes, or cases, which may be made of copper, and into which steam is to be admitted through suitable tubes. These boxes are shallow, but of considerable horizontal, or nearly horizontal, surface. Their upper sides are to be fluted, or corrugated, to cause any liquid passing over them to be retarded in its passage. They are placed with the inclination necessary for the descent of a fluid from one end of the box to the other. There may be any desired number of such boxes acting in succession, high steam being admitted into the first, and said steam being successively conducted into the others. The apparatus is described with considerable minuteness, and represented in several figures. The following are the claims made.

"A patent is hereby claimed for the application of the above-described apparatus, or evaporator, in order to produce instantaneous, and continued evaporation of liquid, from a less to a greater density, by means of the multiplied application of steam, or vapour, through the use of several evaporators in one machine, as described in the above specification, whether the first evaporators be heated by means of the direct action of fire, by means of heated gas, or by means of the caloric of vapour; also, for the application of the principle, that steam may be heated to any greater degree, without increasing its tension, as above described."

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32. For a *Furnace for Manufacturing Iron*; Isaac C. Bryant, city of Philadelphia, December 31.

The patentee states that he constructs his furnace with several new features, and that he denominates it "the combined hot air blast furnace." He says, "I improve the furnace by constructing its inner walls above the customary bosh, or spreading and making a secondary bosh or enlargement of the interior of the furnace above the first or customary bosh, and above the said contraction. A second or third contraction, and a third or fourth bosh may be added if found expedient, the object being to diminish the pressure of coal on the lower or customary bosh, and the liability to wedging or compression of the coal at the lower part of the furnace when anthracite is used."

Another improvement is in making recesses, or grooves, on the inner surface of the furnace, extending vertically up from the crucible, in order to allow of the ascent of air, and to diminish the heat near the crucible; the manner of heating the air, is also varied from the methods heretofore pursued; and water tuyeres of a novel construction are employed. We must, however, refer to the following claims for the other particulars named in the specification. We have seen specimens of iron of very good quality made in this furnace, but we believe that the plan has been abandoned, or its use, at present suspended, as is the case with a number of the furnaces intended for smelting by means of anthracite.

Claim. "What I claim as my improvement, is,

"1st. The application of the contraction, and the second bosh with one, or more additional contractions and boshes, if deemed expedient.

"2nd. The application of the recesses, or grooves, for the purposes mentioned.

"3rd. The application of the air-heating chamber, surrounding the upper portion of the furnace, and the arrangement by which it is effected, the object being convenience, and economy of fuel; the said chamber being constructed and arranged in the manner set forth.

"4th. The use of an elongated opening in each of the water tuyeres, for the purpose already stated.

"5th. The use of boxes, or cases, containing water, constantly shifted by a current placed around the crucible, so as to absorb a portion of its heat, and increase its durability. These boxes may be made in number and breadth, only equal to the water tuyeres, or they may be increased either in number or in breadth, so as to form an entire circle round the crucible. Their size and thickness may be varied as experience may prove to be expedient They may be extended in height, from the bottom of the crucible to the top of the square of the crucible.

6th. The combination of the above improvements, or new modes of construction, or of any one or more of them, with a furnace built in the ordinary manner in other respects, or in such a manner as may be chosen by the founder.

33. For *Metallic frames for neck Stocks, and Cravat stiffeners*; John Johnson, city of New York, December 31.

These stiffeners are made of wire, which is so bent as to spring outwards around the edges of the stock; the contrivance appears to be peculiarly well adapted to stocks intended for wear in summer. The claim is to the manner of making such frames, as described, and represented.

34. For an improved *Regulator for paper making engines;* John M. Hollingsworth, Braintree, Norfolk county, Massachusetts, December 31.

"In ordinary engines the gudgeons of the shaft of the beating cylinder rest in bearings attached to the upper faces of two beams, or *lighters*, the end of one of which is capable of being raised or depressed by a screw operating thereon. The object of the above improvement is to regulate the distance from time to time, between the cutting edges of the knives of the beater, and those of the knives of the block. As these regulating screws have heretofore been turned by the hand of the workman, or attendant on the engine, the same depending on his judgment, or skill, it will be evident that any neglect of duty, or want of necessary judgment on his part, has been of material disadvantage, not only to the converting of rags to the consistence of pulp, but to the interests of the paper maker." The machinery which forms the subject of this patent, is intended to correct this evil, and it was our design to give a general description of the apparatus, but we find that the matter would occupy more space than can now be afforded, as, though not absolutely complex, it still would be with difficulty rendered clear without the drawings. The claim is to the regulating the downward motion of the lighter by means of a cam, particularly formed for that purpose, and also, by means of an inclined plane acting on the lighter, or on the extremity of a pitman connected to the lighter, as set forth.

35. For an improved mode of constructing the *Gaft of Sail Vessels*; John Brown, Stonington, New London county, Connecticut, December 31.

"My invention consists in providing a semi-cylindric saddle, to be affixed in the swallow tail of the ordinary gaft of sail vessels, and which in its use both strengthens the mast, and prevents the same from being chafed and worn by the swallow tail of the gaft." The saddle is to be made concave, and adapted to the mast, and it is to be attached to the gaft by a bolt passing through suitable eyes in the back of it, allowing a free motion, up and down to the gaft. The claim is to "the application of such a saddle to the swallow tail of a gaft, operating in the manner set forth."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for an improvement in the mode of smelting Iron Ores, and in the manufacturing of Steel; granted to JOSEPH RICHARDS, *of the City of Philadelphia, December 10th*, 1838.

In smelting iron ores, the object is to produce a carbonate of iron; the process hitherto known as best adapted to this end is by using charcoal for the fuel, and limestone for the flux. The substitution of coke for the fuel, or any of the mineral coals, does not produce iron so highly carbonated as that which is smelted by the use of charcoal.

My improvement consists in the use of one, or more iron cylinders, or other vessels conveniently placed, and similar to the apparatus in common use for producing pyroligneous acid, and capable of containing compactly, half a cord of wood, or any other desired quantity; dry wood evolves more acid than green, and white oak is the best.—Vinegar, or acetic acid, may be used instead of wood, and the cylinder, or vessels, may be adapted to these substances.

The cylinders or vessels containing the wood or acids must be tightly closed, and furnished with a pipe that will conduct the gas evolved into a furnace above the blast. The cylinder or vessel must then be heated to a temperature that will disengage the gas, and drive it into the furnace. The gas from half a cord of dry white oak will continue to evolve for twenty-four hours. The use of clay, as commonly practiced, will hinder the gas from escaping out of the furnace, and it will be rapidly absorbed by the metal in the fusion, and cause it to have an increased affinity for the carbon evolved from the fuel and limestone, and the iron will be thus furnished with a full charge of carbon.

In converting iron into steel, the present process is by the slow operation of the carbon, which is disengaged from the charcoal, and is absorbed by the metal bars. My improvement consists in the direct use, application, or introduction of pyroligneous, or acetic, acid, in the gaseous state, into the steel furnace, in manner as aforesaid, which will cause the iron to have an increased affinity for the carbon evolved from the fuel, and which will thus become more rapidly charged with the carbon; my improvement will be found to be most useful, when coke, mineral coal, or fuel other than charcoal, is used in the steel furnace.

What I claim as my invention and discovery, and desire to secure by letters patent, is the direct use, application, or introduction, of pyroligneous or acetic acids, in a gaseous state, into the process of smelting iron ores, and in the manufacturing of steel. JOSEPH RICHARDS.

Remarks by the Editor.—We apprehend that the above patent has been obtained upon hypothetical conclusions, and not after practical trial. The patentee is a skilful manufacturer of white lead, and he seems to have concluded that the vapour of vinegar, or pyroligneous acid will act upon the ores of iron in their reduction, and upon steel in cementation, as it acts upon the oxide of lead at the very moderate temperature at which that oxide is carbonated. We believe, however, that the fair deduction from what is known of chemical affinities relating to this matter, would be that the vaporous, or gaseous, acid, would not be absorbed by the heated metal, or in any way contribute to its carbonization. The experiment, however, is one of no great difficulty, but we are not aware that it has been made.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the Strength and other Properties of Cast Iron obtained from the Hot and Cold Blast. By William Fairbairn, Esq.

[CONTINUED FROM PAGE 345.]

The Elsicar and Milton being the only Yorkshire irons obtained answering to the description of hot and cold blast, it may be proper, in this part of my report, to state that I have been favoured with a series of experiments made at the Low Moor Works, near Bradford, by Mr Dawson, one of the proprietors. In the year 1830 the hot blast was tried in the reduction of the ores of the Bradford district. A number of bars, one inch square, were cast from iron produced in the cold blast furnace of 1829, and a similar number of bars were cast, of the same dimensions, and from the same model and furnace, with hot blast, in 1830. Each of the bars was broken with weights placed on the centre, and supported on beams, or bearers, three feet asunder. The results are below:

Mean breaking weight of the Cold Blast bars	947 lbs.
Mean do. do. Hot Blast bars	787 "
Difference in favour of Cold Blast	160

being as 94 to 78 in the ratio of 1000 to 831, or nearly the same in favour of the cold blast as exhibited in the preceding tables.

It appears somewhat remarkable, that the same, or nearly the same, results should be obtained in my experiments of 1836, on the Elsicar and Milton irons, as were elicited in the experiments at the Low Moor in 1830. In both instances there is an obvious defect in the strengths of the iron made by the hot blast; and, judging from the difference in the deflections between the Elsicar and the Milton, I should consider the hot blast more *tender* than the Elsicar, and less worthy of trust than it, when submitted to forcible strain under vibratory action; the power to sustain impact being in favour of the former as 1000 to 875. Before closing these observations, I would venture to mention the striking anomaly that exists between the Yorkshire ores and those of other districts when operated upon by the hot blast. From the experiments generally, such a marked difference does not exist in the strength of other irons as are herein portrayed in those of Yorkshire. Some peculiar, and probably unknown, affinity in the minerals may be brought into action by the heated air; otherwise, I confess, I cannot perceive any just reason for such a change. The mere heating of atmospheric air to 600° or 700° before it enters the furnace, should not, in my opinion, differ so considerably from the same air heated in the furnace. I hope the results of these experiments will induce Dr. Faraday, Dr. Thompson, or some other eminent chemist, to inquire further into this subject, and, by correct analysis, to ascertain the cause of differences which at the present moment appear anything but satisfactory.

Table VII.—Scotch Iron.—Carron No. 3 Pig-Iron, Cold Blast.

Experiment 1. Depth of bar, 1.020 Breadth of do. 1.010 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth of bar, .997 Breadth of do. 1.001 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth of bar, .995 Breadth of do. 1.005 Distance between supports, 4 ft. 6 in.			Experiment 4. Depth of bar, 1.02[illegible] Breadth of do. 1.000 Distance between supports, 2 ft. 3 in.			Experiment 5. Depth of bar, [illegible] Breadth of do. .99[illegible] Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.	Weight in lbs.	Deflection in inches.	Deflection, Load removed.
28	.068	..	28	.071	+	28	.070	+	112	.032	..	112	.032	..
56	.129	+	56	.140	.007	56	.138	.007	224	.067	+	224	.071	+
112	.253	.010	112	.278	.013	112	.270	.011	336	.100	+	336	.110	+
168	.401	.020	168	.430	.027	168	.422	.025	448	.137	.006	448	.149	.007
224	.552	.038	224	.590	.046	224	.587	.046	560	.177	.009	560	.189	.010
280	.718	.061	280	.755	.069	280	.749	.067	672	.215	.014	672	.233	.017
336	.890	.090	336	.946	.098	336	.928	.095	784	.258	.022	784	.280	.023
392	1.079	.120	392	1.142	.136	392	1.122	.132	896	broke		896	.337	.037
448	1.281	.169	420	1.249		420	1.223					952	broke	
469	broke		434	broke		448	broke							
∴ Ultimate deflection = 1.351. Broke 1 inch from the centre.			∴ Ultimate deflection = 1.297. Broke ⅜ of an inch from the centre.			∴ Ultimate deflection = 1.315. Broke 3-8 of an inch from the centre.			∴ Ultimate deflection = .297. Broke 1¼ inch from the centre.			∴ Ultimate deflection = .360. Broke ½ an inch from the centre.		

Carron No. 3, cold blast, indicates (when viewed with a magnifier) an exceedingly close texture, with a rich, sparkling, gray colour. For No. 3 iron, it possesses more than usual softness, and yields freely either to the chisel, or the file. I should consider it in no way inferior to most No. 2 irons in relation to its power of being worked.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection (d).	Product $b \times d$ or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports.	7054	16259100	446.3	1.410	629.3
Experiment 2nd, bar 4 ft. 6 in. between supports,	7135	15987300	436.2	1.293	564.0
Experiment 3rd, bar 4 ft. 6 in. between supports,	..	16494500	450.2	1.307	588.4
Mean,	7094	16246966	444.2	1.336	593.9
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	854.5	.3041	259.9
Experiment 5th, bar 2 ft. 3 in. between supports,	..	..	937.9	.3629	340.3
Mean,	..	..	896.2	.3335	300.1

TABLE VIII.—Scotch Iron.—Carron No. 3 Pig-Iron, Hot Blast.

Experiment 1. Depth bar .996 Breadth 1.002 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth bar, 1.006 Breadth 1.015 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth bar, .989 Breadth 1.001 Distance between supports, 4 ft. 6 in.			Experiment 4. Depth bar, 1.002 Breadth 1.002 Distance between supports, 2 ft. 3 in.			Experiment 5. Depth bar, .993 Breadth .998 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection load removed.	Weight in lbs.	Deflection in inches.	Deflection load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.068	..	28	.067	..	28	.069	..	112	.032	..	112	.034	..
56	.128	+	56	.126	..	56	.132	+	224	.061	..	224	.069	..
112	.250	.006	112	.241	.006	112	.255	.005	336	.097	..	336	.100	..
168	.378	.010	168	.371	.011	168	.391	.013	448	.128	..	448	.137	+
224	.519	.020	224	.510	.020	224	.532	.023	560	.161	+	560	.172	.006
280	.662	.036	280	.647	.033	280	.681	.037	672	.198	.006	672	.208	.009
336	.809	.052	336	.789	.049	336	.831	.055	784	.232	.010	784	.244	.013
392	.974	.077	392	.941	.070	392	1.000	.079	896	.273	.016	886	.290	.019
448	1.142	.106	448	1.104	.093	448	1.174	.110	952	.293	..	952	.312	
476	1.230		504	1.276	.129	476	1.270		1008	.318	.022	1008	broke	
504	broke		532	1.377		504	broke		1064	.340				
			553	broke					1120	broke				
∴ Ultimate deflection =1.312. Broke $\frac{1}{4}$ of an in. from the centre.			∴ Ultimate deflection = 1.440. Broke $\frac{3}{8}$ of an in. from the centre.			∴ Ultimate deflection = 1.356. Broke at the centre.			∴ Ultimate deflection=.362. Broke $\frac{1}{2}$ an inch from the centre.			∴ Ultimate deflection = .332. Broke $\frac{1}{4}$ of an in. from the centre.		

Carron No. 3, hot blast, is a harder iron, with less lustre than its predecessor the cold blast; it is also worked with greater difficulty, and produces a harsh, sonorous sound under the file. It is an iron well adapted for mixing, and of value in heavy castings when used in conjunction with some of the best Welsh irons.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking Weight (b).	Ultimate deflection (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7056	17813700	507.0	1.307	662.6
Experiment 2nd, bar 4 ft. 6 in. between supports,	7056	17949900	538.3	1.448	779.5
Experiment 3rd, bar 4 ft. 6 in. between supports,	..	17855700	514.7	1.341	690.2
Mean,	7056	17873100	520.0	1.365	710.7
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	1113.3	.3627	403.8
Experiment 5th, bar 2 ft. 3 in. between supports,	..	..	1024.0	.3297	337.6
Mean,	..	..	1068.6	.3462	370.7

Comparative results of Carron Iron No. 3.

Distance between supports 4 ft. 6 in. and 2 ft. 3 in.

Strength of Cold Blast Iron.		Strength of Hot Blast Iron.		Ratio of Strengths.
446.3	444.2	507.0	520.0	1000 : 1170
436.2		538.3		
450.2		514.7		
854.5	896.2	1113.3	1068.6	1000 : 1192
937.9		1024.0		
Mean ratio of strengths, 1000 : 1181				

Results of products, and ratio to resist impact.

Product of strength by ultimate deflection in Cold Blast Iron.		Product of strength by ultimate deflection in Hot Blast Iron.		Ratio of products, or of power to resist impact.
629.3	593.9	662.6	710.7	1000 : 1196
564.0		779.5		
588.4		690.2		
259.9	300.1	403.8	370.7	1000 : 1205
340.3		337.6		
Mean ratio of power to sustain impact, 1000 : 1201				

TABLE IX.—Scotch Iron.—Muirkirk No. 1, Cold Blast.

Experiment 1. Depth of bar, 1.015 Breadth of do. 1.007 Distance between supports, 4 ft. 6 in.			Experiment 2. Depth of bar, 1.049 Breadth of do. 1.025 Distance between supports, 4 ft. 6 in.			Experiment 3. Depth of bar, 1.013 Breadth of do. 1.003 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.042 Breadth do. 1 025 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.076	..	28	.067	..	112	.035	..	112	.035	..
56	.150	+	56	.133	+	224	.076	..	224	.070	..
112	.298	.013	112	.267	.010	336	.117	+	336	.112	+
168	.471	.030	168	.421	.027	448	.160	.007	448	.152	.007
224	.660	.053	224	.589	.049	560	.206	.010	560	.192	.011
280	.862	.085	280	.767	.077	672	.250	.018	952	.400	
336	1.096	.131	336	.961	.111	784	.309	.029	980	broke	
392	1.339	.186	392	1.177	.159	896	.377	.045			
448	1.650	.284	448	1.420	.227	952	.410				
476	broke		476	1.554		1008	broke				
			483	broke							
∴ Ultimate deflection=1.781. Broke at the centre.			∴ Ultimate deflection=1.583. Broke at the centre.			∴ Ultimate deflection =.440. Broke $\frac{1}{2}$ an inch from the centre.			∴ Ultimate deflection=.412. Broke $\frac{5}{8}$ of an inch from the centre.		

The Muirkirk No. 1, cold blast, is a remarkably fine, soft iron, with large, open and brilliant crystals, of a bluish gray colour; it presents great regularity in its crystaline structure, the crystals slightly diminishing in size as they recede from the centre. In its working properties, as well as in appearance, it is much akin to the Elsicar and Low Moor iron, and from its fluidity and strength may be safely used for every purpose of casting.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (*b*).	Ultimate deflection (*d*).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	7050	14050600	458.8	1.808	829.5
Experiment 2nd, bar 4 ft. 6 in. between supports,	7177	13956500	428.2	1.660	710.8
Mean,	7113	14003550	443.5	1.734	770.1
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	979.3	.4457	436.5
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	880.6	.4293	378.0
Mean,	..	..	929.9	.4375	407.2

Table X.—Muirkirk No. 1 Pig Iron, Hot Blast.

Experiment 1. Depth of bar, 1.015 Breadth of do. 1.010 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long.			Experiment 2. Depth of bar, 1.025 Breadth of do. 1.035 Distance between supports, 4 ft. 6 in. Weight of bar 5 ft. long.			Experiment 3. Depth of bar, 1.020 Breadth of do. 1.020 Distance between supports, 2 ft. 3 in.			Experiment 4. Depth of bar, 1.035 Breadth do. 1.029 Distance between supports, 2 ft. 3 in.		
Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.	Weight in lbs.	Deflection in inches.	Deflection, load removed.
28	.079	..	28	.069	..	112	.043	..	112	.037	..
56	.160	+	56	.144	+	224	.090	.005	224	.073	+
112	.326	.013	112	.287	.011	336	.138	.008	336	.112	.005
168	.507	.029	168	.445	.021	448	.185	.010	448	.152	.008
224	.700	.051	224	.610	.036	560	.231	.015	560	.190	.011
280	.909	.082	280	.780	.059	672	.289	.022	672	.230	.014
336	1.141	.129	336	.978	.090	784	.357	.039	784	.277	.020
392	1.428	.207	392	1.190	.135	812	broke		896	.328	.031
420	1.571		420	1.310					952	.354	
441	broke		448	broke					1008	broke	
∴ Ultimate deflection = 1.668. Broke $2\frac{3}{8}$ inch. from the centre.			∴ Ultimate deflection = 1.412. Broke $2\frac{3}{8}$ inch. from the centre.			∴ Ultimate deflection = .371. Broke $\frac{1}{2}$ an inch from the centre.			∴ Ultimate deflection = .378. Broke at the centre.		

This iron is inferior to the Muirkirk No. 1 cold blast; it is what is technically called *Kishie*, or full of a great variety of rich crystals sparkling in the midst of a duller and more compact mass; an appearance which is invariably present in irons of great fluidity and richness.

In the turning and filing process it is superior to the Carron No. 2 cold blast; and equal in every other respect, except strength, to any of the former irons we have experimented upon.

Results reduced to those of bars 1.00 *inch square.*

	Specific gravity.	Modulus of elasticity in lbs. per square inch.	Breaking weight (b).	Ultimate deflection in inches. (d).	Product $b \times d$, or power of resisting impact.
Experiment 1st, bar 4 ft. 6 in. between supports,	6948	12805700	423.8	1.693	717.5
Experiment 2nd, bar 4 ft. 6 in. between supports,	6959	13783100	412.0	1.447	596.1
Mean.	6953	13294400	417.9	1.570	656.8
Experiment 3rd, bar 2 ft. 3 in. between supports,	..	..	765.2	.3784	289.5
Experiment 4th, bar 2 ft. 3 in. between supports,	..	..	914.5	.3912	357.8
Mean,	..	..	839.8	.3848	323.6

Comparative results of Muirkirk Iron No. 1.

Distance between supports, 4 ft. 6 in. and 2 ft. 3 in.

Strength of Cold Blast Iron.	Strength of Hot Blast Iron.	Ratio of strengths.
458.8 428.2 Mean 443.5	423.8 412.0 Mean 417.9	1000 : 942
979.3 880.6 929.9	765.2 914.5 839.8	1000 : 912
	Mean ratio of strengths,	1000 : 927

The products and ratio to resist impact.

Products of strength by ultimate deflection in Cold Blast Iron.	Products of strength by ultimate deflection in Hot Blast Iron.	Ratio of products, or of power to resist impact.
829.5 710.8 770.1	717.5 596.1 656.8	1000 : 852
436.5 378.0 407.2	289.5 357.8 323.6	1000 : 794
	Mean ratio of power to sustain impact,	1000 : 823

Modulus of elasticity in lbs. for a base of an inch square.

Cold Blast Iron,	14,050,600	Hot Blast Iron,	12,805,700
Ditto,	13,956,500	Ditto,	13,783,100
Mean,	14,003,550	Mean,	13,294,400

Effects of Time.

In former experiments on the transverse strength of cast-iron, it has been assumed that the elasticity remained perfect to the extent of one-third, at least, of the breaking weight. This assumption, which has been attempted to be proved by Tredgold, has gained considerable credence; but so far as I can perceive there appears to be no ground for such an opinion. In the earlier experiments on the subject of hot and cold blast irons, it was observed by Mr Hodgkinson that in some cases the elasticity was considerably injured with one-fifth or one-sixth of the breaking weight. This fact was of such importance as to induce me to pay considerable attention to the set in the preceding tables, and also to note the defects of elasticity in those that follow, up to the time of the weights becoming permanent upon the bars. From the methods thus adopted it will be seen that the value of the set has been given with the deflections at regular intervals of weights, from the commencement of the experiment to the time of fracture, and the connexion between the weights, deflections, and set, will therefore in all probability be better observed.

The early period at which the elasticity became injured caused, in addition to the above, an extended series of experiments, to determine whether such injury to the elasticity would not (with the weight continued) ultimately break the bar. This became a debatable, and very important, question between Mr. Hodgkinson and myself; the one contending for time, and the other for a permanent state of elasticity in the ratio of the loads and the forces respectively.

The inquiry therefore was, to what extent can cast-iron be loaded, or how much would it permanently bear without endangering its security? This was in reality a question of great interest, one which involved important considerations, such as the stability of bridges, warehouses, factories, and many other erections to which cast-iron is applied, and which depends almost entirely upon our knowledge of its ductility and strength.

It assuredly must be of importance to know that a material of such value, and so extensively used in almost every branch of art, can be trusted, and that we may with safety depend upon its security throughout the endless variety of forms and strains to which it is subjected.

Cast-iron has hitherto been considered a brittle, and, by many persons, an insecure material; yet, notwithstanding the distrust and suspicion with which it was viewed, it still continues to increase in demand, and that to a great extent, in most countries where the arts are cultivated. Every inquiry therefore which tends to exhibit its peculiar properties as respects strength, ductility, &c., must be regarded as an additional step towards a greater degree of security in its application. Under these impressions the following experiments were instituted.

Five bars of cold, and five of hot blast, Coed-Talon No. 2 iron, cast to be one inch square, were selected, and having loaded them with different weights, with their ends supported on props 4 feet 6 inches asunder, they were left in this position, to determine how long they would sustain the loads without breaking.

It is now upwards of 15 months since the bars were charged, and if we are to judge from the hardihood displayed in their resistance to the load, there is every chance of a long and protracted experiment. In fact, there is every probability of the experiments outliving the experimenter.

TABLE XI.

Table of deflections as exhibited with permanent weights of 280 lbs. suspended from the centre of bars of cold and of hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 feet 6 inches.

Experiment 1. Cold blast iron No. 2. Depth of bar, 1.050 Breadth of do. 1.030			Date of observation. 1837	Temperature at the time of observation.	Experiment 2. Hot blast iron No. 2. Depth of bar, 1.050 Breadth of do. 1.010			
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.			Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	
56	.144	..			56	.153	..	
112	.309	.020			112	.337	.022	
168	.499	..			168	.548	..	
224	.708	.075			224	.784	.088	The permanent weight, 280lbs. was fixed stationary upon the cold blast bar at 6 o'clock p.m., March 8th 1837, and an equal weight was left to remain upon the hot blast bar on the following day at 10 a.m.
280	.916	.108	March 9th	49°	280	1.043	.132	
280	.930		Do. 11th	..	280	1.064		
280	.932		Do. 17th	..	280	1.067		
280	.930		April 15th	47	280	1.078		
280	.932		May 31st	62	280	1.082		
280	.937		Aug. 22nd	70	280	1.086		
280	.942		Nov. 18th	45	280	1.083		
280	.941		Jan. 8, 1838	38	280	1.086		
280	.945		March 12th	51	280	1.091		
280	.963		June 23rd	78	280	1.107		

From observations taken this day, June 23rd, the mean deflection for 15 months was found to be, for cold blast .936, increase .004, for hot blast, 1.079, increase .012.

Results in the preceding Table, showing the progressive and increased ratio of deflections from March 11*th*, 1837, *to June* 23*rd*, 1838.

Cold Blast Iron, deflection in inches.	Date of observation	Temp.	Hot Blast Iron, deflection in inches.	Ratio of increase of deflections.
1.684	March 11th, 1837.	..	1.064	..
1.824	June 23rd. 1838.	78°	1.107	..
.033	Increase.	..	.043	1000 : 1303

From the above it appears, that a progressive increase, in the deflections of the bars, has taken place, since the time they were charged, in the ratio of 1000, for the cold blast, to 1303, for the hot blast.

The hot blast bar in these experiments being more deflected than the cold blast, indicates that the particles are more extended and compressed in the former iron, with the same weights, than in the latter. This excess of deflection may in some degree account for the rapidity of increase, which it will be observed is considerably greater in the hot than in the cold blast bar.

The next experiment was from the same metal, cast as before into rectangular bars 1 inch square, and loaded with additional weights, amounting to 336 lbs. on each bar.

TABLE XII.

Table of deflections as exhibited with permanent weights of 336 lbs. suspended from the centre of bars of cold and of hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 ft. 6 in.

Experiment 1. Cold blast iron No. 2. Depth of bar, 1.020 Breadth of do. 1.030			Date of Observation.	Temperature at the time of observation.	Experiment 2. Cold blast iron No. 2. Depth of bar, 1.040 Breadth of do. 1.020		
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	1837&1838.		Weight in lbs.	Observed deflection in inches.	Deflection, load removed.
56	.148	..			56	.160	..
112	.318	.028			112	.346	.026
168	.515	..			168	.567	..
224	.732	.086			224	.809	.092
280	.961	..			280	1.077	..
336	1.221	.192			336	1.374	.212
			1837				
336	1.267		March 6th		336	..	
336	1.270		Do. 9th	49°	336	1.454	
336	1.270		Do. 11th	49	336	1.461	
336	1.271		Do. 17th	49	336	1.462	
336	1.271		April 15th	47	336	1.475	
336	1.274		May 31st	62	336	1.481	
336	1.288		Aug. 22nd	70	336	1.504	
336	1.286		Nov. 18th	45	336	1.499	
			1838				
336	1.288		Jan. 8th	38	336	1.502	
336	1.298		March 12th	51	336	1.505	
336	1.316		June 23rd	78	336	1.538	

The weight, 336 lbs., was left permanent on the cold blast bar on Friday, March 3rd, at 6 o'clock p.m. The same weight (336 lbs.) was fixed stationary upon the hot blast bar on Tuesday, March 7th, at 11 o'clock, a.m.

When the weights, 336 lbs., were placed on the cold blast bar, after the elasticity had been taken, the deflection increased from 1.221 to 1.267.

On the hot blast bar the deflection increased with the restoration of the weights from 1.374 to 1.397. The mean deflection under various temperatures is, for the cold blast 1.280, increase .009; for the hot blast 1.486 increase .024.

Results in the preceding Table, showing the progressive and increased ratio of deflections from the 11*th of March,* 1837, *to* 23*rd of June,* 1838.

Cold Blast Iron, deflection in inches.	Date of observation	Temp.	Hot Blast Iron, deflection in inches.	Ratio of increase of deflections.
1.270	March 11th, 1837	..	1.461	
1.316	June 3rd, 1838	78°	1.538	
.046	Increase.	..	.077	1000 : 1673

The ratio of increase is here much greater than what is indicated by the lesser weights—280 lbs.—in Table, No. XI. The progression towards fracture (providing we assume a progressive yielding in that direction) is advancing at a quicker rate in this case than with the lighter loads; consequently the resisting powers are becoming gradually weaker. We must, however, observe that the temperature of the air in the room where the bars are placed was at 78° when the last observations were made, whereas the temperature was only 46° at the time the bars were first loaded. This difference in the temperature will give rather greater deflections, from the expansion produced on the bars in a medium of 78°. In confirmation of this opinion I would beg to refer to the observations of November 18th when the atmosphere of the room was at 45°; the deflections had then decreased from 1.288 to 1.286 in the cold blast iron; and from 1.504 to 1.499 in the hot blast iron.

TABLE XIII.

Table of deflections as exhibited with permanent weights of 392 lbs. suspended from the centre of bars of cold and of hot blast Coed-Talon Iron, cast to be one inch square and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 ft. 6 in.

Experiment 1. Cold Blast Iron No. 2 Depth of bar, 1.030 Breadth do. 1.020			Date of Observation.	Temperature at the time of observation.	Experiment 2. Hot Blast Iron No. 2 Depth of bar, 1.050 Breadth of do. 1.000			
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	1837&1838.		Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	
56	.153	.005			56	.150	..	The weight, 392 lbs., was fixed stationary on the cold blast bar, on Friday, March 3rd, at 12 o'clock, and the same weight was placed upon the hot blast bar at 11 o'clock, a.m., on the following day. On re-instating the weight after the deflection and defects of elasticity had been taken, the deflection had increased in the cold blast from 1.616 to 1.636, and from 1.635 to 1.661 in the hot blast.
112	.334	.022			112	.333	.023	
168	.541	..			168	.551	..	
224	.769	.089			224	.775	.086	
280	1.013	..			280	1.029	..	
336	1.294	.199			336	1.311	.188	
392	1.616	.292			392	1.635	.272	
392	1.684		March 6th		392	1.715		
392	1.694		Do. 9th	49°	392	1.758		
392	1.694		Do. 11th		392	1.760		
392	1.694		Do. 17th		392	1.763		
392	1.716		April 15th	47	392	1.767		
392	1.725		May 31st	62	392	1 775		
392	1.737		Aug. 2nd	70	392	1.783		
392	1.724		Nov. 18th	45	392	1.773		
			1838					
392	1.722		Jan. 8th	38	392	1.773		
392	1.801		March 12th	51	392	1.784		
392	1.824		June 23rd.	78	392	1.803		

Mean deflection thro'-out all the changes of temperature in 15 months.—For the cold blast 1.742, increase .048; hot blast 1.777, increase .014.

Results in the preceding Table, showing the progressive and increased ratio of deflections from March 11th, 1837, to June 23rd, 1838.

Cold Blast Iron, deflection in inches.	Date of observation	Temp.	Hot Blast Iron, deflection in inches.	Ratio of increase of deflections.
1.684	March 6th, 1837.	..	1.715	..
1.824	June 23rd, 1838.	78°	1.803	..
.140	Increase.	..	.088	1000 : 628

On comparing the above with Table No. XII, preceding it, there will be found a greater proportionate deflection in both the cold and hot blast bars than is observable with the lighter weights of 336 lbs., and in both instances the deflection is greater in the hot than in the cold blast. The same is the case in experiment 2nd of the next Table, where the deflection indicated by 348 lbs. is less than what is exhibited on the hot blast with 336 lbs., being as 1.437 to 1.803. This may be accounted for by the bars which were newly cast containing, in all probability, a greater proportion of carbon, and consequently having more ductility than those in Tables No. XII and No. XIV.

The ratio of increase in the deflections is much higher in the cold blast iron than the hot; and notwithstanding the silent and apparently progressive approach towards rupture, there is every appearance of a long and tedious experiment. It cannot however be doubted that fracture will sooner take place in the cold than in the hot blast, as the former is advancing to that point with greater rapidity, or in the ratio of 1000 to 628. We may therefore expect the bar from the cold blast iron to be the first to give way, and probably about the time when the deflection verges on two inches.

TABLE XIV.

Table of deflections as exhibited with permanent weights of 448 lbs. suspended from the centre of bars of cold and hot blast Coed-Talon iron, cast to be one inch square, and left to determine the effect produced on each bar after given intervals of time.

Distance between supports 4 ft. 6 in.

Experiment 1. Cold Blast Iron No. 2. Depth bar, 1.000 Breadth 1.010			Experiment 2. Cold Blast Iron No. 2. Depth bar, 1.020 Breadth 1.030			Date of Observation. 1837 & 1838.	Temperature.	Experiment 3. Hot Blast Iron No. 2. Depth bar, 1.040 Breadth 1.010			Remarks.
Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	Weight in lbs.	Observed deflection in inches.	Deflection, load removed.			Weight in lbs.	Observed deflection in inches.	Deflection, load removed.	
56	.155	..	56	.129	..			56	.165	..	The permanent weights, 448 lbs., were placed, in ex. 1, upon the cold blast bar on Saturday, the 4th March, at 4 o'clock p.m., 1837, and the same weights became stationary on the cold blast bar, in ex. 2, on the previous day, at 4 o'clock p.m. In ex. 3, 392 lbs. broke the bar; several other bars of hot blast were tried, but they successively broke on lying on the weights, 448 lbs. Mean deflection for 15 months, ending 23rd June, was for cold blast 1.431, increase 0.28.
112	.333	.021	112	.264	.009			112	.360	.025	
168	.536	..	168	.416	..			168	.579	..	
224	.755	.076	224	.578	.039			224	.829	.086	
280	.992	..	280	.754	..			280	..	..	
336	1.262	.167	336	.934	.087			336	1.419	.208	
392	1.556	..	392	1.131	..			392	broke with this weight.		
448	1.904	..	448	1.361	.192						
						1837.					
448	1.964	.404	448	1.410		March 6					
448	2.005		448	1.413		Do. 9	49°				
448	2.005		448	1.413		Do. 11					
448	2.010		448	1.413		Do. 17					
448	2.014	broke after sustaining the load 37 days. The deflection increased from 1.904 to 1.964 after the defects of elasticity were last taken.									
			448	1.422		April 15	47				
			448	1.424		May 31	62				
			448	1.438		Aug. 22	70				
			448	1.431		Nov. 18	45				
						1818.					
			448	1.430		Jan. 8	38				
			448	1.429		March 12	51				
			448	1.457		June 23	78				

Results in the preceding Table, showing the progressive and increased ratio of deflections from March 6th, 1837, *to June 23rd,* 1838.

Cold Blast Iron, deflection in inches.	Date of observation	Temp.	Hot Blast Iron, deflection in inches.	Ratio of increase of deflections.
Experiment 3.				
1.410	March 6th, 1837.	..		
1.457	June 23rd, 1838.	70°		
.047	Increase.	..		

The greater degree of weakness here exhibited in the hot blast iron than the cold renders our comparative experiments in this Table defective; several bars were tried in succession, but they separately gave way, some on laying on the load, 448 lbs., and others after supporting it for a few seconds.

In experiment 1st, Table XIV., it will be noticed that a bar from the cold blast iron, after being charged with the full load, 448 lbs., continued to support it for a period of 37 days; this was not, however, accomplished without signs of weakness, as will be seen from the progressive increase which took place in the deflections from the 6th to the 17th of March; and also from observed discrepancies some time previous to its rupture. In making these statements it must be observed, that the bar in experiment 1st was thinner than any of the others, and had borne for thirty-seven days a weight greater than had broken bars of the same size in previous experiments upon the Coed-Talon iron, when the weights were laid on without loss of time.

Abstract of comparative increase and ratio of deflections on the whole bars from March 6th, 1837, *to June 23rd,* 1838.

	Cold Blast Iron, increase of deflection in inches.	Hot Blast Iron, increase of deflection in inches.	Ratio of deflections.
Increase of deflection, Table XI.	.033	.043	..
Increase of deflection, Table XII.	.046	.077	..
Increase of deflection, Table XIII.	.140	.088	..
Increase of deflection, Table XIV.	.047	..	..
Mean,	.066	.069	1000 : 1045

The mean increase of deflections on the whole bars is therefore .066 for the cold blast, and .069 for the hot blast, being in the ratio of 1000 to 1045.

The interest which experiments of this kind may be expected to excite, and the nature as well as the value of the material on which they are here made, will, it is hoped, prove an inducement for extended investigation on this subject.

[TO BE CONTINUED.]

Manufacture of Lead Pencils.

The best black-lead pencils of this country are formed of slender parallelopipeds, cut out by a saw from sound pieces of plumbago, which have been previously calcined in close vessels at a bright red heat. These parallelopipeds are generally enclosed in cases made of cedar wood, though of late years they are also used alone, in peculiar pencil cases, under the name of ever-pointed pencils, provided with an iron wire and screw, to protrude a minute portion of the plumbago beyond the tubular metallic case, in proportion as it is wanted.

In the year 1795, M. Conté, a French gentleman, well acquainted with the mechanical arts, invented an ingenious process for making artificial black-lead pencils of superior quality, by which he and his successor and son-in-law, M. Humblot, have realized large fortunes.

Pure clay or clay containing the smallest proportion of calcareous or siliceous matter, is the substance which he employed to give aggregation and solidity, not only to plumbago dust, but to all sorts of coloured powders. That earth has the property of diminishing in bulk, and increasing in hardness, in exact proportion to the degree of heat it is exposed to, and hence may be made to give every degree of solidity to crayons. The clay is prepared by diffusing it in large tubs through clear river water, and letting the thin mixture settle for two minutes. The supernatent, milky liquor is drawn off by a syphon from near the surface, so that only the finest particles of clay are transferred into the second tub, upon a lower level. The sediment which falls very slowly in this tub, is extremely soft and plastic. The clear water being run off, the deposit is placed upon a linen filter, and allowed to dry. It is now ready for use.

The plumbago must be reduced to a fine powder in an iron mortar, then put into a crucible, and calcined at a heat approaching to whiteness. The action of the fire gives it a brilliancy and softness which it would not otherwise possess, and prevents it from being affected by the clay, which it is apt to be in its natural state. The less clay there is mixed with the plumbago, and the less the mixture is calcined, the softer are the pencils made of it; the more clay used the harder are the pencils. Some of the best pencils made by M. Conté, were formed of two parts of plumbago and three parts of clay; others of equal parts. This composition admits of indefinite variations, both as to the shade and hardness; advantages not possessed by the native mineral. While the traces may be made as black as those of pure plumbago, they have not that glistening aspect which often impairs the beauty of black-lead drawings. The same lustre may, however, be obtained by increasing the proportion of powdered plumbago relatively to the clay.

The materials having been carefully sifted, a little of the clay is to be mixed with the plumbago, and the mixture is to be triturated with water into a perfectly uniform paste. A portion of this paste may be tested by calcination. If, on cutting the indurated mass, particles of plumbago appear, the whole must be further levigated. The remainder of the clay is now to be introduced, and the paste is to be ground with a muller upon a porphyry slab, till it be quite homogeneous, and of the consistence of thin dough. It is now to be made into a ball, put upon a support, and placed under a bell glass inverted in a basin of water, so as to be exposed merely to the moist air.

Small grooves are to be made in a smooth board, similar to the pencil parallelopipeds, but a little longer and wider, to allow for the contraction of volume. The wood must be boiled in grease, to prevent the paste from sticking to it. The above described paste being pressed with a spatula into these grooves, another board, also boiled in grease, is to be laid over them very closely, and secured by means of screw-clamps. As the atmospheric air can get access only to the ends of the grooves, the ends of the pencil pieces become dry first, and by their contraction in volume get loose in the grooves, allowing the air to insinuate further and to dry the remainder of the paste in succession. When the whole piece is dried, it becomes loose, and might be turned out of the grooves. But before this is done, the mould must be put into an oven moderately heated, in order to render the pencil pieces still drier. The mould should now be taken out, and emptied upon a table covered with cloth. The greater part of the pieces will be entire, and only a few will have been broken, if the above precautions have been duly observed. They are all, however, perfectly straight, which is a matter of the first importance.

In order to give solidity to these pencils, they must be set upright in a crucible till it is filled with them, and then surrounded with charcoal powder, fine sand, or sifted wood ashes. The crucible, after having a luted cover applied, is to be put into a furnace, and exposed to a degree of heat regulated by the pyrometer of Wedgewood; which degree is proportional to the intended hardness of the pencils. When they have been thus baked, the crucible is to be removed from the fire, and allowed to cool with the pencils in it.

Should the pencils be intended for drawing architectural plans, or for very fine lines, they must be immersed in melted wax, or suet, nearly boiling hot, before they are put into the cedar cases. This immersion is best done by heating the pencils first upon a gridiron, and then plunging them into the melted wax or tallow. They acquire by this means a certain degree of softness, are less apt to be abraded by use, and preserve their points much better.

When these pencils are intended to draw ornamental subjects with much shading, they should not be dipped as above.

Second process for making artificial pencils, somewhat different from the preceding.—All the operations are the same, except that some lamp-black is introduced along with the plumbago powder and the clay. In calcining these pencils in the crucible, the contact of air must be carefully excluded, to prevent the lamp-black from being burned away on the surface. An indefinite variety of pencils, of every possible black tint, may thus be produced, admirably adapted to draw from nature.

Another ingenious form of mould is the following:

Models of the pencil-pieces must be made in iron, and stuck upright upon an iron tray, having edges raised as high as the intended length of the pencils. A metallic alloy is made of tin, lead, bismuth and antimony, which melts at a moderate heat. This is poured into the sheet-iron tray, and after it is cooled and concreted, it is inverted, and shaken off from the model bars, so as to form a mass of metal perforated throughout with tubular cavities, corresponding to the intended pencil-pieces. The paste is introduced by pressure into these cavities, and set aside to dry slowly. When nearly dry, the pieces get so much shrunk that they may be readily turned out of the moulds upon a cloth table. They are then to be completely desiccated in the shade, afterwards in a stove-room, next in the oven, and lastly ignited in the crucible, with the precautions above described.

M. Conté recommends the hardest pencils of the architect to be made of lead melted with some antimony and a little quicksilver.

In their further researches upon this subject, M. Conté and M. Humblot found that the different degrees of hardness of crayons could not be obtained in a uniform manner by the mere mixture of plumbago and clay in determinate doses. But they discovered a remedy for this defect in the use of saline solutions, more or less concentrated, into which they plunged the pencils, in order to modify their hardness, and increase the uniformity of their texture. The non-deliquescent sulphates were preferred for this purpose: such as sulphate of soda, &c. Even sirop was found useful in this way.—*Dr. Ure's Dict.*

Mech. Mag.

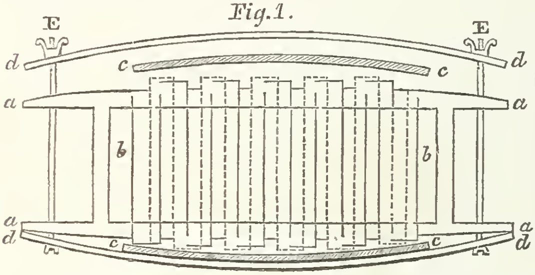
Description of a Voltaic Battery. By S. E. Hoskins, *M. D. Communicated in a letter to the Editor.*

Sir,—The plate voltaic battery, although nearly superseded by the more modern cylindrical arrangements, is still of sufficient value to sanction an endeavour towards improving its construction.

If the following description of a method I have devised for its simplification be worthy of a place in your excellent Annals, I shall be obliged by its insertion.

The various inconveniences arising from the usual methods of connecting galvanic plates, and the difficulty of cleansing the zincs when soldered to the coppers, induced me some time ago to seek a more simple mode of effecting junction. The result is a method whereby solder, mercury cups, and binding screws are dispensed with; and perfect connexion between a dozen or eighteen pair of plates effected by the mere adjustment of a couple of thumb screws.

Fig.1.



2.

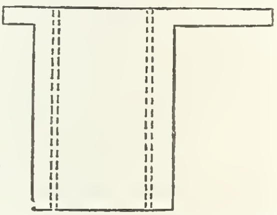


Fig. 1, represents a wooden frame with fine transverse saw cuts, half an inch deep, and one fourth or one sixth of an inch apart. This frame is intended to fit over a trough without partitions. Each of its projecting extremities is perforated for the passage of a brass bolt, having a head at one end and a deep thread for the reception of a thumb screw at the other.

The plates which are dropped into the transverse saw cuts of the frame, alternately interlacing, according to Messrs. De la Rue and Young's plan, are cut out of copper and thin sheet zinc.*

The plates being dropped into the frame, the long ears are to be bent over its convex sides, so that a zinc shall be in contact with a copper plate. This being done, a strip of wood is placed over the bent ears: over this is a strip of brass, and the whole bound together by the bolts and thumb screw, until perfect contact is secured.

This arrangement will be better understood by reference to fig. 1, which gives a transverse view of the apparatus.

a, a, a, a, are the plano-convex sides of the frame. *b, b, b, b,* the alternating plates of zinc and copper. *c, c, c, c,* thin strips of white deal, varnished, and barely long enough to cover the series of overlapping ears. *d, d, d, d,* strips of thick sheet brass, as long as the sides of the frame, and perforated at each extremity. E, E, bolts and thumb screws, which are represented as having tightened the binders on one side, and in readiness to do so on the other.

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*The thinner the better, as it can be readily cut and bent, and does not require wide saw cuts, which would weaken the frame;—lasts quite long enough for one durable operation, and admits of fresh plates being used each time.

The dotted lines, in fig. 2, are intended for pieces of varnished cord permanently fixed on the copper plates: a simple but effectual method of keeping the plates asunder.

The battery may be used with dilute acid, or with the acidulated solution of sulphate of copper, recommended by M. De la Rue. With the latter, good decomposing action will continue for upwards of an hour; at the end of which time three inches of fine platinum wire can be kept in a state of incandescence for half an hour, or more. In short, the power of the battery is quite equal to that of other plate arrangements possessing advantages peculiar to itself. These advantages are convenience in an extended sense of the word, and economy both of time and money. Eighteen or twenty pair of plates may be sundered and put together again in a few minutes; the zincs therefore may be washed, amalgamated, or replaced, with great facility and without the use of the soldering tool, the waste of mercury, or the annoyance arising from a series of binding screws. A stock fashioned by the manipulator may always be kept at hand with no more expense than that of the material; and he may extend his series with ease to any extent.

The only parts which cannot in general be made by the amateur are the trough, the screws, and the frame. The latter requires some degree of nicety in its construction,—none however which a common carpenter, properly directed, may not attain.

A small battery, such as I have described, has been deposited at the Polytechnic Institution, ever since the month of October. Mr. Bachhoffner, to whose kindness on all occasions I am much indebted, has performed a series of carefully conducted experiments with it, and allows me to state in his name that my battery is much more powerful than others of the same order, owing to the approximation of the plates, and that it is much more convenient and manageable than any. Sturgeon's Annals of Elec.

'*Experimental Researches upon the Cost of the Light afforded by different Lamps and Candles*,' *by Andrew Ure, M. D., F. R. S., &c.*

The author having instituted a series of experiments to determine the advantages of Mr. Parker's new hot oil lamp, adopts as the standard of comparison the French mechanical lamp, in which the oil is raised by machinery, so as continually to overflow at the bottom of the burning wick. The relative illumination was determined by the well-known method of the equal intensity of shadows, and verified by that adopted by Professor Wheatstone, namely, by the relative brightness of the opposite sides of a revolving ball. The chimney of the new lamp differs from the chimneys of other lamps in having a bell-mouthed glass chimney, and above it a chimney of iron, with a parted diaphragm for the purpose of causing a certain portion of the heat of the flame to reverberate against the interior cylindric cavity of the oil cistern. The bell mouth is formed in a mould, and is far better suited for producing a steady flame than the rectangularly contracted chimney of the mechanical lamp. The intensity of the shadows from the mechanical lamp and hot oil lamp of a wire a few inches long, and of the thickness of a crow-quill, was equal, at a distance of 10 and 11 feet respectively; their relative illuminations being as the squares of these, are, 100 and 121 respectively, and the consumption of the best sperm oil was 15.2 and 11.6 grains per minute;

the relative cost of illumination for this oil would then appear to be 50 per cent. in favour of the new lamp. On trying Southern whale oil, the cost of illumination appeared to be about one-third that of the mechanical, and one-half that of the hot oil lamp with sperm oil. The author tried many other substances, and, comparing the various illuminations, concludes that the hot oil lamp with Southern whale oil affords an economy of light nearly 12 times greater than stearine or German wax candles, $7\frac{1}{2}$ times greater than tallow mould, 11 times greater than cocoa nut, $8\frac{1}{2}$ times greater than Palmer's, $17\frac{1}{2}$ times greater than spermaceti, and 18 times greater than wax candles. The author had also compared the illumination produced by one of the Fresnel's Lamps deposited at the Trinity House. This lamp consists of four concentric, circular wicks, placed in a horizontal plane, the innermost being $\frac{7}{8}$ths of an inch, and the outermost $3\frac{1}{2}$ inches in diameter. The intensity of the shadows from this and from the mechanical lamp were equal at a distance of 13 feet 3 inches, and 4 feet 6 inches respectively; taking the squares of these, the Fresnel lamp gives about nine times the light of the mechanical, which latter may be assumed as equal to that of eleven average wax candles. On comparing one of the best Argand-lamps with the mechanical, the former was to the latter as 10 to 11; so that the illumination of the Fresnel lamp, instead of being, as has been asserted, equal to 40 Argand lamps, is not equal to more than 9.6 of those lamps. In the Bude light, a small stream of oxygen is sent up through a small tube within a burning wick, which is $\frac{5}{8}$ths of an inch in diameter, and the flame of about $\frac{3}{8}$ths of an inch. The illuminating power is equal to about 30 wax candles. Dr. Ure also examined the illuminating power of different kinds of wax candles, and found that the light from a long-three and a short-three was the same, or $\frac{1}{11}$th of the mechanical lamp; also the light emitted from one of the six-to-the-pound was very little less, being $\frac{1}{12}$th of that of the mechanical lamp. The consumption of wax in a long or short-three may be taken at 126 grains per hour, and in a short-six at 125 grains per hour. Wax contains 81.75 parts of carbon in every 100 parts, and the combustion of these 100 parts produces 36 parts of carbonic acid; consequently, a wax candle will generate per hour about 375 grains of carbonic acid, or 800 cubic inches of gas. Now an average sized man developes and exhales from his lungs 1632 cubic inches of gas per hour; thus the combustion of two ordinary wax lights injure the air to about the same extent as the breathing of one man.

Athenæum.

On the injurious Effects of Kyan's Anti-Dry-Rot Solution, as regards the Destruction of vegetable Life in the Gardens at Thoresby, Nottinghamshire. Communicated by the Right Hon. the Earl of Manvers.

Some of the rafters in one of the pine and grape houses in Thoresby Park, having become quite decayed by dry rot, Earl Manvers was recommended to use timber for the new rafters which had been steeped in one of Kyan's patent tanks. Accordingly, ten new rafters for the roof lights to work upon were put up in February, 1837; such rafters being first steeped in the solution, at the strength of one pound of corrosive sublimate to ten gallons of water. These rafters were in use one year before being painted, and in that time totally killed three fine vines trained to the first three rafters, and seriously injured those trained to the remaining seven rafters; so much so, indeed, as to quite kill the fruit upon them; and, in fact, such was the injurious effect of the poisonous vapour drawn from the wood, that the fruit in the remainder of the house was of a very inferior description. The pine plants standing immediately under these rafters were seriously injured, and a considerable number of them were quite destroyed; the remainder, on being placed in the fruiting pit, in a very short time put up a small weak premature fruit.

The cause of this great damage to both the vines and pine plants, was the damp vapour which arose from the heat of the house; and also from rain soakage occasionally falling upon them.

In the spring of 1838, these rafters were carefully painted four times over; but, although the injurious effects were thereby in some degree diminished, yet the plants looked unhealthy, and did not fruit properly.

At the present time, the young vines are looking yellow, and have not a single bunch of grapes upon them; and the pines under these ten rafters are weak and unhealthy, when compared with those at the other end of the house.

In 1837, twelve young vines in pots were watered with water taken from a tank in part supplied from the roof of this hot-house, and these plants were all killed in a very short time.

A trellis-work flower stand, made of deal timber that had been steeped in the solution, was placed in a small green-house in the gardens, and if this had not been taken out, every plant in the house would have been killed by the noxious vapour arising from the wood. The plants soon came round again after the removal of the trellis.* Gardener's Magazine.

Galvanic Decomposition.

Mr. Spencer detailed the following experiment. He took a piece of sulphuret of copper, and placed it in a narrow glass vessel half filled with sulphate of copper in solution, and immersed the sulphuret about half its length in this solution. He then added common salt, taking care that it should not intermingle with the cupreous solution underneath. He then placed it in the dark, and left it for a week. At the end of that time he examined it, and had the satisfaction of observing that several portions of it had become covered with very minute crystals of the pure metal. At the end of a fortnight still more beautiful crystals had been deposited. This experiment, Mr. Spencer stated, was made for the purpose of corroborating the experiment of Mr. Fox, in which that gentleman took a small portion of sulphuret of copper, to which he attached a piece of copper wire, and at the other end a portion of zinc; the arrangement was separated by a wall of clay, with sulphate of copper in solution in one cell, and a saline solution in the other. Mr. Spencer conceived, that by his arrangement the objection to Mr. Fox's experiment was overcome, viz. that it was always necessary to suppose the presence of two metals. Athenæum.

Drainage of Lands by Steam Power.

The drainage of land by steam power has been extensively adopted in the fens of Lincolnshire, Cambridgeshire, and Bedfordshire, and with immense advantage. A steam engine of ten horse power has been found to be sufficient to drain a district comprising 1000 acres of land, and the water can always be kept down to any given distance below the plants. If rain fall in excess, the water is thrown off by the engine; if the weather is dry, the sluices can be opened and the water let in from the river. The engines are required to work four months in the twelve, at intervals varying with the season, where the districts are large; the expense of drainage by steam power is about 2*s*. 6*d*. per acre. The first cost of the works varies with the different nature of the substrata, but generally it amounts to 1*l*. per acre for the machinery and buildings. An engine of forty horse power, with scoop wheels for draining, and requisite buildings, costs about 4000*l*., and is capable of draining 4000 acres of land. In many places in the fens, land has been purchased at from 11*l*. to 20*l*. per acre, which has been so much improved by drainage, as to be worth from 60*l*. to 70*l*. per acre.—*Durham Advertiser.* Mining Review.

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*Of the conservative efficacy of the Kyan Solution upon the woody fibre which has imbibed it, several articles in our pages afford satisfactory evidence;—of the remarkably deleterious nature of the effluvium from the surface of timber, thus treated, upon vegetable life, the above paper furnishes an instance singularly striking and demonstrative G.

Progress of Physical Science.

Establishment of Magnetic Observatories, and Naval Expedition for Magnetic Purposes.

We are glad to learn, that the following interesting Report (which is unfortunately without a date) has produced its desired effect upon her Majesty's Ministers, who have appointed three officers of Artillery, with adequate attendants, to go respectively to Montreal, to the Cape of Good Hope, and to St. Helena, to make the experiments on the variations, and dip of the needle, and the intensity of magnetism, frequently and simultaneously each day, for three years; Capt. Ross (the nephew of Sir J. Ross) is also appointed to go out in a ship for the same period, and make similar experiments and observations at various places specified by the Committee of the Royal Society. We shall rejoice if the results are as curious and valuable as the scientific projectors anticipate.

Report of a Joint Committee of Physics and Meteorology referred to, by the Council of the Royal Society, for an opinion on the propriety of recommending the establishment of fixed magnetic observatories, and the equipment of a naval expedition for magnetic observations in the Antarctic Seas, to Her Majesty's Government, and to report generally on the subject: together with the Resolutions adopted on that Report, by the Council of the Royal Society.

Report.

The subject of terrestrial magnetism has recently received some very important accessions which have materially affected, not only the point of view in which henceforward it will be theoretically contemplated, but also the modes of observation which will require to be adopted for completing our knowledge of the actual state of the magnetic phenomena, and furnishing accurate data for the construction and verification of theoretical systems. It was for a long time supposed that the changes in the position assumed by the needle at any particular point on the earth's surface might be conceived as resulting from regular laws of periodicity, having for their arguments, 1st, a great magnetic cycle of several centuries, depending on unknown, and perhaps internal, movements or relations; and 2ndly, on the periodic alternations of heat and cold, depending on the annual and diurnal movements of the sun. The discovery of the affection of the needle by the aurora borealis, and of the existence of minute and irregular movements, which might be referred either to unperceived auroras or to other local and temporary causes, sufficed to show that the laws of terrestrial magnetism are not so simple as to admit of this summary form of expression; and the important discovery, first announced, we believe, by Baron Von Humboldt, that those temporary changes take place simultaneously at great distances in point of locality, a discovery which has since been remarkably confirmed and extended to very great intervals of distance, so as to include the whole extent of the European continent, by Gauss and Weber, and their coadjutors of the German Magnetic Association, has sufficed to show that the gist of the inquiry lies deeper, and depends upon relations far more complex, while at the same time the dominion of what might previously have been regarded as local agency, would require, in the new views consequent on the establishment of these facts, to be extended far beyond what ordinary usage would authorize as a just application of that epithet.

For a long time in the history of terrestrial magnetism, the variation alone was attended to. The consideration of the dip was then superadded; but the observation of this element being more difficult and delicate, our knowledge of the actual and past state of the dip over the earth's surface is lamentably deficient. It has lately appeared, however, that this element can be observed with considerable approximation, though not with nicety, at sea, so that no reason subsists why materials for a chart of the dip analogous to that of variation should not be systematically collected. Lastly, the intensity has come to be added to the list of observanda; and from the great facility and exactness with which it can be determined, this branch of magnetic knowledge has in fact made most rapid progress.

These three elements, the Horizontal Direction, the Dip, and the Intensity, require to be precisely ascertained before the magnetic state of any given station on the globe can be said to be fully determined. Nor can either of them, theoretically speaking, be said to be more important than the others, though the direction, on account of its immediate use to navigators, has hitherto had the greatest stress laid upon it, and been reduced into elaborate charts. A chart of the lines of total intensity has been recently constructed by Major Sabine.

All these elements are, at each point, now ascertained to be in a constant state of fluctuation, and affected by those transient and irregular changes which are above alluded to; and the investigation of the laws, extent, and mutual relations of these changes is now become essential to the successful prosecution of magnetic discovery, for the following reasons.

1st. That the progressive and periodical, being mixed up with the transitory changes, it is impossible to separate them so as to obtain a correct knowledge and analysis of the former, without taking express account of and eliminating the latter, any more than it would be practicable to obtain measures of the sea-level available for an inquiry into the tides, without destroying the irregular fluctuation produced by waves.

2ndly. That the secular magnetic changes cannot be concluded from comparatively short series of observations without giving to those observations extreme nicety, so as to determine with perfect precision the mean state of the elements at the two extremes of the period embraced, which, as already observed, presupposes a knowledge of the casual deviations.

3rdly. It seems very probable that discordances found to exist between results obtained by different observers, or by the same at different times, may be, in fact, *not* owing to error of observation, but may be due to the influence of these transitory fluctuations in the elements themselves.

4thly and lastly, Because the theory of these transitory changes is in itself one of the most interesting and important points to which the attention of magnetic inquirers can be turned, as they are no doubt intimately connected with the general causes of terrestrial magnetism, and will probably lead us to a much more perfect knowledge of those causes than we now possess.

Actuated by these impressions, on the occasion of a letter addressed by Baron Von Humboldt to His Royal Highness the Duke of Sussex, P.R.S., the Council of this Society, on April 13, 1837, resolved to apply to Government for aid in prosecuting, in conjunction with the German Magnetic Association, a series of simultaneous observations; and in consequence of an application founded on such their resolution, a grant of money was obtained for the purchase of instruments for that purpose. By reason, however, of the details and manipulations of the methods then recently introduced into magnetic observations by Gauss, being at that time neither completely perfected, nor their superiority over the old methods fully established by general practice, the precise apparatus to be employed in these operations was not at the time agreed upon, and was still under discussion, subject to the report of the Astronomer Royal on the performance of an instrument on Gauss's principle established at Greenwich, at the time when the subject in its present more extended form was referred by the Council to this Joint Committee, so that the grant in question has not, in point of fact, been employed or called for. The Committee consider this as in some respects fortunate, as in consequence of the delay, time has been given for a much maturer consideration of the whole subject; and should it now be taken up as a matter of public concern, they consider that it will be necessary to provide for a more continuous and systematic series of observations, by observers regularly appointed for the purpose, and provided with instruments and means considerably more costly than those contemplated on the occasion in question.

On the general advisableness of calling for public assistance in the prosecution of the extensive subject of terrestrial magnetism, in both the modes referred to them for their consideration, (viz. by magnetic observatories established at several stations properly selected on land, and by a naval expedition expressly directed to such observations in the Antarctic Seas,) your Committee are fully agreed. They consider the subject to have now attained a degree of theoretical, as well as of practical, importance, and to afford a scope for the application of exact inquiry which it has never before enjoyed, and which are such as fully to justify its recommendation by the Royal Society to a revival of that national support to which we are indebted for the first chart of variations constructed by our illustrious countryman Halley in A. D. 1701, on the basis of observations collected in a voyage of discovery expressly equipped for that purpose by the British Government.

As regards the first branch of the question referred to their consideration, they are of opinion that the stations which have been suggested to them, viz. Canada, St. Helena, the Cape, Van Diemen's Land, and Ceylon (or Madras), are well selected, and perhaps as numerous as they could venture to recommend, considering the expense which would require to be incurred at each, and that in each of these stations it would be desirable; 1st, That regular hourly observations should be made (at least during the daytime) of the fluctuations of the three elements of variation, dip, and intensity, or their equivalents, with magnetometers on the more improved construction, during a period of three years from their commencement.

2ndly. That on days, and on a plan appointed, agreed on in concert with one another, and with European observatories, the fluctuations of the same elements should be observed during twenty-four successive hours, strictly simultaneous with one another, and at intervals of not more than five minutes.

3rdly. That the absolute values of the same elements shall be determined at each station, in reference to the fluctuating values above mentioned, with all possible care and precision, at several epochs comprehended within the period allowed.

4thly. That in the event of a naval expedition of magnetic discovery being dispatched, observations be also instituted at each fixed station, in correspondence with, and on a plan concerted with the Commander of, such Expedition.

As regards the second branch of the subject referred to them, viz. the proposal of an Antarctic voyage of magnetic researches, they are of opinion, as already generally expressed, that such a voyage would be, in the present state of the subject, productive of results of the highest importance and value; and they ground this opinion on the following reasons:—

1st. That great and notorious deficiencies exist in our knowledge of the course of the variation lines generally, but especially in the Antartic seas, and that the true position of the southern magnetic pole or poles can scarcely even be conjectured with any probability from the data already known.

2ndly. That our knowledge of the dip throughout those regions, and the whole southern hemisphere, is even yet more defective, and that even such observations of this element as could be procured at sea, still more by landing on ice, &c., would have especial value.

3rdly. That the intensity lines in those regions rest on observations far too few to justify any sure reliance on their courses over a large part of their extent, and over the rest are altogether conjectural. Nevertheless that there is good reason to believe in the existence and accessibility of two points of maximum intensity in the southern, as in the northern, hemisphere, the attainment of which would be highly interesting and important.

4thly. That a correct knowledge of the courses of these lines, especially where they approach their respective poles, is to be regarded as a first, and, indeed, indispensable preliminary step to the construction of a rigorous and complete theory of terrestrial magnetism.

5thly. That during the progress of such an expedition, opportunities would of necessity occur (and should be expressly sought) to observe the transitory fluctuations of the magnetic elements in simultaneous conjunction with observations at the fixed stations, and in Europe, and so to furnish data for the investigation of these changes in localities very unlikely to be revisited for any purposes except those connected with scientific inquiries.

Your Committee, in making this Report, think it unnecessary to go into any minute details relative to the instruments, or other materials, required for the proposed operations, still less into those of the conduct of the operations themselves. Should such be required from them, it will then be time to enter further into these and other points, when the Committee will most readily devote themselves to the fullest consideration of the subject.

J. F. W. Herschel,
Chairman of the Joint Physical and Meteorological Committee.

Resolutions of the Council.

1. That this Report be received and approved.

2. That the Council, deeply impressed with the importance of the scientific objects which might be attained by an Antarctic Expedition, particularly by the institution of magnetic observations in the southern regions, do earnestly recommend that Her Majesty's Government be pleased to direct the equipment of such an expedition.

3. That the imperfect state of our present knowledge of the amount and fluctuations of the magnetic elements, renders the establishment of fixed magnetical observatories, for a limited time, at various points of the earth's surface, highly desirable, particularly in Canada, St. Helena, Van Diemen's Land and Ceylon, and at the Cape of Good Hope; and that the Council do earnestly recommend Her Majesty's Government to cause such observatories to be established.

4. That a deputation, consisting of the President, Treasurer, and Secretaries of the Society, Sir John F. W. Herschel, the Chairman, and Major Sabine and Mr. Wheatstone, the Secretaries of the joint Committee of Physics and Meteorology, be requested to communicate the above Resolutions to Lord Melbourne, and to urge on the Government the adoption of the measures therein proposed.

Instructions for making Meteorological Observations.[*]

The suggestions which the Council wish to offer will relate, 1st, to the times of observation; 2ndly, to the situation of the instruments to be observed; 3rdly, to the correction of the observations; 4thly, to a form of registry, which may place many of the results in a striking point of view, and facilitate comparisons.

1. *Barometers.*

Times of observation.—The purposes of meteorological observations would be most perfectly and most expeditiously obtained by hourly observations throughout the year; but as at present such a course of unremitting labour cannot be hoped for, it is necessary to select periods, at longer intervals, calculated to embrace the extremes of the periodical oscillations to which the pressure of the atmosphere is subject, and to ensure that uniformity of system at different stations on which the value of such observations so much depends. It is probable that the hours of 3 A. M., 9 A. M., 3 P. M., and 9 P. M., nearly coincide with the daily maxima and minima of the barometric column at the level of the sea, over a large portion of the globe; and it is desirable that as extensive a comparison as possible should be instituted at these hours.

It is not, however, too much to expect that in regular observatories hourly observations should be made, for 24 hours, once in every month; and when this cannot be effected, it is of the utmost importance that they should be made at least four times in the year, namely, at the summer and winter solstices, and at the spring and autumn equinoxes. One of the results of these hourly observations would, probably, be the indication of the exact times of the daily maxima and minima of pressure at different stations, which, if not found to coincide with the hours provisionally adopted, might ultimately be substituted for them under future directions.

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[*] Extracted from "Instructions for the Scientific Expedition to the Antarctic Regions, prepared by the President and Council of the Royal Society of London."

Hourly observations at the equinoxes and solstices have been already instituted at numerous points both of Europe and America, at the suggestion of Sir John Herschel, whose directions should be strictly attended to. They are as follows:—

The days fixed upon for these observations are the 21st of March, the 21st of June, the 21st of September, and the 21st of December, being those, or immediately adjoining to those, of the equinoxes and solstices in which the solar influence is either stationary or in a state of most rapid variation. *But should any one of those 21st days fall on Sunday, then it will be understood that the observations are to be deferred till the next day, the 22nd.* The observation at each station should commence at 6 o'clock A. M. of the appointed days, and terminate at 6 A. M. of the days following, according to the usual reckoning of time at the place.

The commencement of each hour should be chosen, and every such series of observations accompanied by a notice of the means used to obtain the time, and, when practicable, by some observation of an astronomical nature by which the time can be ascertained within a minute or two.

The Council now propose to extend these observations in regular series to the 21st of every month, with the same reservation with regard to Sundays.

It is to be hoped that in regular meteorological observations the six-hourly observations may not be found to be impracticable throughout the year; but in any case where it may be impossible to observe regularly at 3 A. M., an effort should be made to include the hour on the days of the new and full moon, and quadratures, or at least on the days of the new and full moon;—as it must be borne in mind, that in what concerns the great meteorological questions on which the most interesting features of the subject depend, the night is quite as important as the day, and has been hitherto far too much neglected.

It is much to be wished that occasional observations may be made under remarkable circumstances, such as during great rises or great falls of the barometer, at the period of great storms, earthquakes, &c.; but such observations should be registered apart.

The barometer should be placed in an apartment subject to as little variation of temperature as possible, and in a good light; and to facilitate night observations, an arrangement should be made for placing behind it a light screened by a sheet of white paper, or other diaphanous substance. Great care should be taken to fix it in a perpendicular position by the plumb-line. Its height must be carefully ascertained above some permanent and easily-recoverable mark, either in the building in which it is situated, or in some more permanent building, or rock, in its immediate vicinity; and no pains should be spared to ascertain the relation which such mark may bear to the level of high and of low water at spring tides, and ultimately to the mean level of the sea.

Changes in the adjustments of meteorological instruments should be most carefully avoided; but whenever any alteration may be absolutely necessary, they should be made with all deliberation, scrupulously noticed in the register, and the exact amount of the change thence arising in the reading of the instrument under re-adjustment ascertained. As far as possible, registers of meteorological observations should be complete; but if, by unavoidable circumstances of absence, or from other causes, blanks occur, no attempts to fill them up by general recollection, or by the apparent course of the numbers before and after, should ever be made.

2. *Thermometers.*

Times of observation.—The external standard thermometer should be observed and registered at the same times as the barometer, and all the register thermometers may be read off at the time of the 9 A. M. observation, and their indices re-adjusted. But as double maxima frequently, and double minima occasionally, occur, in consequence of sudden changes of temperature, both the thermometers should be occasionally inspected with a view to ascertain whether the motion of either the mercury or the spirit has been reversed in an unusual manner; and such double maxima or minima should be recorded apart as *supernumerary*, with the dates and leading features of the case.

In placing the standard thermometer, an exposure should be chosen perfectly shaded from the sun, one where no reflected sunbeams from water, buildings, rocks, or dry soil, can reach it, and one which is easily accessible for observation. It should be *fixed*, not merely *hung*, upon a bracket projecting six inches from the wall, or other support to which it may be attached, and it must be *completely* sheltered from rain by a screen, so that the bulb shall never be wetted. In reading it, the observer should avoid touching, breathing on, or in any way warming, it by near approach of his person; and in night observations particular care should be taken not to heat it by approximation of the light. The quicker the reading is done the better.

Notice should, of course, be taken of all sudden and remarkable changes of temperature, although such occasional observations must not be recorded in the regular series.

The self-registering thermometers should be placed with the same precautions as the standard, and so fastened as to allow of one end being detached, and lifted up to allow of the indices within the tubes sliding down to the ends of the fluid columns, which they will readily do with the assistance of occasional tapping.

The self-registering thermometers are apt to get out of order by the indices becoming entangled, or from the breaking of the column of fluid. When this happens with the spirit thermometer, it may be rectified with ease by jerking the index down to the junction of the bulb and tube. The whole of the tube will at the same time become wetted with the spirit, and by setting it on end with the bulb downwards the spirit will run together into one continuous column.

When the steel index of the mercurial thermometer becomes immersed in the mercury, it must be jerked in the opposite direction, till it, with the mercury which may be above it, is projected into the little bulb at the top of the tube. If this do not succeed, heat must be applied to the mercury-bulb, and when the index is fairly lodged in the air-bulb, by carefully warming the mercury-bulb with a spirit lamp having a very small flame, the mercury must be made to expand till it rises to the very top of the tube, and projects convexly into the air-bulb. The tube must then be placed upright, and, by tapping, the detached mercury will slip down beneath the steel index, and will fairly unite with the convex projection aforesaid. Now let the bulb cool, and the mercury will sink in one united column, and leave the index free.

Besides the regular series of observations of the temperature of the air, there are other occasional observations to be made of temperature under different circumstances, which might possess great interest.

The surface temperature of the water of the sea or of rivers may be conveniently obtained by taking up a bucket-full of water and stirring round the thermometer in it.

The temperature of the water of deep wells may be ascertained in the same way, and should be taken monthly, if near the residence of the observer. The temperature of rain should also be attended to at times; it may be determined by receiving the rain in a *linen* funnel, totally enclosed in a tin case to prevent cooling by evaporation from the linen.

The temperature of the soil at different depths is a point of considerable importance. For this purpose excavations should be made in a dry sheltered situation, 3, 6, and 9 feet deep, and lined with brick or earthenware tubes. In the bottom of these excavations earthenware quart bottles may be carefully placed, filled with water, spirit, or brine, and corked. They must be carefully covered with tow or cotton, and drawn up on the 21st of every month (being the day of horary observation), and their temperatures taken by an accurate thermometer, and registered apart.

As a general caution it may be mentioned, that the *standard* thermometer should never be exposed to risk by application to such purposes, but thermometers which have been compared and corrected by comparison with it.

3. *Actinometers.*

Amongst the observations of highest importance must be ranked those of the force of solar and terrestrial radiation. The most perfect means of observing the former is afforded by the actinometer.

This instrument consists of a large hollow cylinder of glass, soldered at one end to a thermometer-tube, terminated at the upper end by a ball drawn out to a point, and broken off, so as to leave the end open. The other end of the cylinder is closed by a silver or silver-plated cap, cemented on it, and furnished with a screw, also of silver, passing through a collar of waxed leather, which is pressed into forcible contact with its thread, by a tightening-screw of large diameter enclosing it, and working into the silver cap, and driven home by the aid of a strong steel key or wrench, which accompanies the instrument.

The cylinder is filled with a deep blue liquid (ammonio-sulphate of copper), and the ball at the top being purposely left full of air, and the point closed with melted wax, it becomes, in any given position of the screw, a thermometer of great delicacy, capable of being read off on a divided scale attached. The cylinder is enclosed in a chamber blackened on three sides, and on the fourth, or face, defended from currents of air by thick glass, removable at pleasure.

The action of the screw is to diminish or increase at pleasure the capacity of the hollow of the cylinder, and thus to drive, if necessary, a portion of the liquid up into the ball, which acts as a reservoir; or, if necessary, to draw back from the reservoir such a quantity as shall just fill it, leaving no bubble of air in the cylinder.

To use the instrument, examine first whether there be any air in the cylinder, which is easily seen by holding it level, and tilting it, when the air, if any, will be seen to run along it. If there be any, hold it upright in the left hand, and the air will ascend to the root of the thermometer-tube. Then, by alternate screwing and unscrewing the screw with the right hand, as the case may require, it will always be practicable to drive the air out of the cylinder into the ball, and suck down liquid, if any, from the ball, to supply its place, till the air is entirely evacuated from the cylinder, and the latter, as well as the whole stem of the thermometer-tube, is full of the liquid in an unbroken column. Then, holding it horizontally, face upwards, slowly and cautiously unscrew the screw, till the liquid retreats to the zero of the scale.

The upper bulb is drawn out into a fine tube, which is stopped with wax. When it is needed to empty, cleanse, and refill the instrument, liquid must first be forced up into the ball, so as to compress the air in it. On warming the end, the wax will be forced out, and the screw being then totally unscrewed, and the liquid poured out, the interior of the instrument may be washed with water slightly acidulated, and the tube, ball, &c. cleansed, in the same way, after which the wax must be replaced, and the instrument refilled.*

4. *Radiating Thermometers.*

As, however, the actinometer can only be observed at intervals in perfectly clear weather, additional information with regard to solar radiation, of much interest, though not of so precise a nature, may be obtained, by the daily register of the maximum temperature of a register thermometer, with a blackened bulb exposed to the full action of the sun's rays. It may be placed about an inch above the bare soil, and screened from currents of air. The maximum temperature indicated by such a thermometer, even in cloudy weather, will generally be considerably above that of the air, and the maxima and mean daily maxima of its indications will, after a long series of observations, afford data of the utmost value to the history of climates. The bulb of the thermometer should be about half an inch in diameter, and it may be uniformly blackened with lamp-black and varnish. The graduation should be made upon the glass stem, to prevent any inconvenience from the expansion and warping of the scale.

The measure of terrestrial radiation is of no less importance to the science of meteorology than that of solar radiation, but no perfect instrument has yet been contrived for its determination. Very valuable information, however, may be derived from the daily register of the minimum temperature of a register spirit-thermometer, the bulb of which is placed in the focus of a parabolic metallic mirror, turned towards the clear aspect of the sky, and screened from currents. The mirrors furnished to the observatories are of silver-plated copper, but planished tin-plate or zinc might be substituted without detriment. They are 6 inches diameter and 2 inches deep, and the thermometers which are graduated upon the stems pass through sockets in their sides, in which they may be accurately adjusted by corks. Their bulbs do not exceed half an inch in diameter.

Even in the day time a thermometer so placed, and turned towards the clear sky, but away from the rays of the sun, will fall several degrees below the temperature of the surrounding air.

*Rules for making an observation with the Actinometer will be found in the Lond. & Ed. Phil. Mag. for Sep. 1839.

5. *Hygrometers.*

Times of observation.—Observations of the *dew-point* hygrometer are as desirable at the regular hours as those of the other meteorological instruments; but, as more difficulty attends the observation, it is more liable to omission, and it is of great importance that when one experiment only can be made, the most advantageous hour should be selected for the purpose. Now it is probable that the minimum temperature of the air in the 24 hours may correspond with the minimum temperature of the dew-point; and for the attainment of a mean result, the time of the highest dew-point should be selected, which would not differ much from 3 P. M., at which hour the observation should on no account be omitted. The hygrometer should also be observed, if possible, at 9 A. M. and 9 P. M., but the minimum temperature might probably be substituted for the 3 A. M. observation without any material error.

Occasional observations of the dew-point under peculiar circumstances, as for instance in the inhabited apartments of houses, or between the decks of the ships when laid up in their winter quarters in the polar regions, could not but afford information of high practical importance.

All the ether of the dew-point hygrometer should be driven by the warmth of the hand from the covered, into the uncovered ball, previously to an observation, and the ether should be dropped from a dropping-bottle very slowly upon the former. The temperature of the interior thermometer should be carefully noted upon the first appearance of the ring of dew upon the black bulb, and also its temperature upon its disappearance: the mean of the two observations, should they differ, may be entered as the dew-point, together with the temperature of the air by the exterior thermometer.

The *wet-bulb* hygrometer can be observed without difficulty, by mere inspection, and the observation should never be neglected at the regular hours. It is probable that the temperature of evaporation thus ascertained may afford the means of accurately determining the dew-point, and of solving all the points of hygrometry; but until all the necessary corrections shall have been agreed upon, one of the most essential requisites must be its frequent and accurate comparison with the dew-point, directly ascertained.

The hygrometers should be placed in the observatory, near to the standard thermometer, with which they should be frequently compared.

6. *Vanes, Anemometers, and Rain Gauges.*

Those who do not possess a register-anemometer may make use of the common vane and Lind's wind-gauge. The position of the former should be clear of all deflections and eddies from objects of the same or a higher level, and of course its position with regard to the true north should be clearly determined. In registering the direction of the wind it may be sufficient to use only 16 points of the compass.

Lind's wind-gauge for measuring the force or momentum of the wind is adjusted for use by filling it with water till the liquid in both legs of the siphon corresponds with the 0° of the scale. It is to be held perpendicularly, with the mouth of the kneed tube turned towards the wind, and the amount of the depression in one leg, and that of its elevation in the other, are to be carefully noted. The sum of the two is the height of a column of water which the wind is capable of sustaining at the time, and every body that is opposed to that wind will be pressed upon by a force equivalent to the weight of a column of water, having its base equal to the surface that is opposed, and its height equal to the altitude of the column of water sustained by the wind in the wind-gauge.

The height of this column being given, the force of the wind on a foot square is easily found by a table which will be given in the appendix.

The observation of the gauge should always be made at the same point of a free space, and in gusty weather the maximum of the oscillation recorded. The most proper periods will be those of the other regular observations; but in great storms, or under other particular circumstances, occasional observations should be made, and registered apart.

The points most important to remark respecting the wind are,

1st. Its average intensity and general direction during the several portions of the day devoted to observation.

2ndly. The hours of the day or night when it commences to blow from a calm, or subsides into one from a breeze.

3rdly. The hours at which any remarkable changes of its direction take place.

4thly. The course which it takes in veering, and the quarter in which it ultimately settles.

5thly. The usual course of *periodical winds*, or such as remarkably prevail during certain seasons, with the law of their diurnal progress, both as to direction and intensity; at what hours, and by what degrees they commence, attain their maximum, and subside; and through what points of the compass they run in so doing.

6thly. The existence of crossing currents at different heights in the atmosphere, as indicated by the courses of the clouds in different strata.

7thly. The times of setting-in of remarkably hot or cold winds, the quarters from which they come, and their courses, as connected with the progressive changes in their temperature.

8thly. The connexion of rainy, cloudy or fair weather, with the quarter from which the wind blows, or has blown for some time previously.

The rain-gauge may be of very simple construction. A cubical box of strong tin or zinc, exactly 10 inches by the side, open above, receives, at an inch below its edge, a funnel, sloping to a small hole in the centre. On one of the lateral edges of the box, close to the top of the cavity, is soldered a short pipe, in which a cork is fitted. The whole should be well painted. The water which enters this gauge is poured through the short tube into a cylindrical glass vessel, graduated to cubic inches and fifths of cubic inches. Hence one inch depth of rain in the gauge will be measured by 100 inches of the graduated vessel, and $\frac{1}{1000}$th inch of rain may be very easily read off.

It is very much to be desired that, being of such easy construction, more than one of these gauges should be erected, or at least one placed with its edge nearly level with the ground, and another upon the top of the highest building, rock, or tree, in the immediate vicinity of the place of observation, the height of which must be carefully determined; it having been satisfactorily ascertained that the height of the gauge above the ground is a very material element in the quantity of rain which enters it. The quantity of water should be daily measured and registered at 9 A. M.

7. *Clouds and Meteors.*

Many very highly-interesting observations may be made, without the aid of instruments, upon the clouds. In describing them, Mr. Howard's nomenclature may be adopted with great advantage. By means of the clouds, different simultaneous currents of wind may often be detected, the different directions of which should be carefully ascertained by referring their motions to some fixed object. Their gradual evaporation or precipitation should also be carefully noted, and particularly their regular disappearance at night, or their more irregular and sudden formation.

Rainbows, parhelia, haloes, &c., will of course be noted amongst the occasional remarks of the register; and an attempt should be made to express approximatively by numbers, the proportion which the overcast portion of the sky may bear to the clear space. For this the hemisphere may be supposed to be divided into eight sections, and the cloudy portion may be expressed by the fraction $\frac{1}{8}$th or $\frac{5}{8}$ths, &c.

8. *Electrometers.*

The Council are fully impressed with the high importance of regular observations on the electrical state of the atmosphere; but they are not prepared to suggest any means of effecting this desirable object, which will at all correspond with the present advanced state of electrical physics. At no distant period they hope to supply a defect which is certainly a reproach to science. In the meantime much valuable information might be acquired by observations of an electroscope, on one of the ordinary constructions connected with a lofty insulated wire.

In erecting such a wire, proper precautions should be taken against accidents by preparing a sufficient conductor in its immediate vicinity, by which a communication could be at once opened with the ground in case of any sudden and dangerous accumulation of the electric fluid.

As a temporary contrivance, a common jointed fishing-rod, having a glass stick well varnished with shell lac, substituted for its smallest joint, may be projected into the atmosphere. To the end of the glass must be fixed a metallic wire terminating in a point, and connected with an electroscope by means of a fine copper wire. If the wire be made to terminate in a spiral wrapped round a piece of cotton dipped in spirits of wine and inflamed, its power of collecting electricity will be sometimes doubled, but great precautions are necessary when this mode is employed. When the electroscope has been charged, the nature of the electricity may be tested in the usual way by excited glass or sealing wax.

The observations made with the principal, existing instruments have demonstrated that in serene weather the electricity of the atmosphere is always positive with regard to that of the earth, and that it becomes more and more positive in proportion to its elevation above the earth's surface; so that if an observer be on a mountain, or in a balloon, if his conductor be directed downwards to reach an inferior stratum of air, his electroscope will indicate negative electricity; and if it be sent upwards into a superior stratum, positive electricity will be manifested. Various means have been resorted to in these experiments, such as connecting one of the extremities of the conducting wire to a kite, a small balloon, or the head of an arrow, the other extremity remaining attached to the electroscope.

It has been ascertained by the observations of De Saussure, Schubler, Arago and others, that the positive electricity of the atmosphere is subject to diurnal variations of intensity, there being two maxima and two minima during the twenty-four hours. The first minimum takes place a little before the rising of the sun; as it rises, the intensity, at first gradually and then rapidly, increases, and arrives at its first maximum a few hours after. This excess diminishes at first rapidly and afterwards slowly, and arrives at its minimum some hours before sunset; it re-ascends when the sun approaches the horizon, and attains its second maximum a few hours after, then diminishes till sunrise, and proceeds in the order already indicated. The intensity of the free electricity of the atmosphere has also been found to undergo annual changes, increasing from the month of July to the month of November inclusive, so that the greatest intensity occurs in winter, and the least in summer.

In cloudy weather the free electricity of the atmosphere is still positive. During storms, or when it rains or snows, the electricity is sometimes positive and sometimes negative, and its intensity is always much more considerable than in serene weather. The electroscope will, during the continuance of a storm, frequently indicate several changes, from positive to negative.

Very recently, a new method of investigating the electric state of the atmosphere has been proposed, likely to lead hereafter to very certain and valuable results; but it has not been sufficiently put in practice to enable the Council to recommend, at the present moment, the best form of instrument for making simultaneous and comparable observations, or the proper precautions to guide the observer in manipulating it.

For the principle of this instrument we are indebted to Mr. Colladon of Geneva. He found, that if the two ends of the wire of a galvanic multiplier, consisting of very numerous coils well insulated from each other, were brought in contact, one with a body positively, and the other with a body negatively charged, a current of electricity passes through the wire, until equilibrium is restored; the energy and direction of this current is indicated by the deviation of the needle from the zero-point of the scale. This instrument is applied to the purpose of ascertaining and measuring the atmospheric electricity, by communicating one end of the wire with the earth, and allowing the other to extend into the region of the atmosphere, the electrical state of which is intended to be compared.

Thunder storms, of course, should be attended to; but it is of consequence also to notice distant lightning not accompanied with thunder audible at the place of observation, especially if it take place many days in succession, and to note the quarter of the horizon where it appears, and the extent which it embraces. In an actual thunder storm, especial notice should be taken of the quantity of rain which falls, and of the fits or intermittences of its fall, as corresponding, or not, to great bursts of lightning, as also of the direction of the wind, and the apparent progress of the storm with or against it.*

Progress of Civil Engineering.

On the Attractive force of a Blast of Air.

When compressed air escapes through an orifice, a very singular phenomenon may be shown, which has not yet found its way into our books of science, although it is well known on the continent. This phenomenon can be exhibited by the following simple experiment:—

If we cut a couple of cards each into a disk of about two inches in diameter, and perforate one of these at the centre, and fix it on the top of a tube, such as the barrel of a common quill; then if we give the other card a little concave bend, and place it over the first, the orifice of the tube being thus

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*On these subjects the Council especially recommend the attentive perusal of Arago's *Notice sur le Tonnerre.*

directly under and almost in contact with the upper card; now, if we try to blow off the upper card, we shall find it impossible to be done.

This remarkable fact seems to have been noticed by several persons independently of each other. The French bring forward no less than three claimants, namely, M. Griffith, Mining Engineer of Fourchambault, and Messrs. Boigues of the same place, who showed the fact to Messrs. Thenard and Clement in September, 1826. About this time also the same fact appears to have been noticed by Mr. Roberts, an intelligent manufacturer of Manchester. We here give the several accounts of the discovery.

M. Griffith says that, if air be powerfully compressed in a reservoir furnished with a circular opening in one of its vertical sides, and we present to the blast of air issuing therefrom a flat piece of board or metal, it will at first be repelled by the violence of the blast; but after forcing it nearer to the aperture, so as to overcome this repulsion, it will be powerfully attracted. In this position the air escapes by diverging between the interior surface of the board or metal, and the rim of the orifice.

The account of Messrs. Boigues is as follows:—A circular opening, one or two inches in diameter, being made in the flat side of a reservoir of compressed air, employed to feed a blast furnace, the air escapes with great violence; but, if we bring near to this opening a disk of wood or metal seven or eight inches in diameter, and having overcome the resistance caused at first by the blast upon the plane surface of the disk, the latter will no longer be repelled; it oscillates rapidly, at the same time receding from and approaching to the opening within very narrow limits. The air continues to escape with great noise between the surface of the disk, and that of the side of the vessel containing the air. If now we wish to withdraw the disk, it will require great muscular exertion to do so; and although the disk be not in actual contact with the side of the air-vessel, it seems as if glued to it.

The next discoverer of this phenomenon is our countryman, Mr. Roberts. Several years ago he had constructed an apparatus for ventilating his manufactory. A pipe, conveying a blast of air, terminated close to the wall of the principal apartment; and with a view to regulate the quantity of air to be introduced, he placed a valve over the terminus of the blast-pipe; but found, to his surprise, that the most powerful blast of air not only would not lift the valve, (which was merely a piece of flat board,) but that it even held the valve firmly down over the mouth of the pipe, so that the strength of one man was insufficient to withdraw it. This experiment has often been shown to visitors as one of the curiosities of Manchester.

This phenomenon can be produced by a blast of any kind of gas or vapour; by steam, and even by water, and other liquids.

The attractive force of a blast of air is particularly remarkable, if we place the card, mentioned at the beginning of this article, with its concave side upwards upon the table, and, with the tube in the mouth, hold the other card over it, and blow through the tube, when the concave card will start up from the table, and adhere to the other.

It has been stated in reference to the experiment with the cards, that the upper card cannot be blown off, because the current of air, which passes between the two cards in consequence of blowing through the tube, is in a more rarefied state than the atmosphere around and above; and that therefore the latter presses upon the two cards, so long as the blast is kept up and causes them to adhere.

But to show that the upper card is not retained in its place merely by atmospheric pressure, the following experiment was performed by Mr. Tomlinson. Let a brass tube, open at both ends, and terminated at the lower end by a perforated screw, be fixed to the table of the air-pump. A disk of card, two inches in diameter, is placed horizontally at the upper end of the tube. Another card of the same size, made slightly concave, is placed over the first. Let the whole be covered with a glass receiver: then let the aïr be removed, which of course can only quit the receiver by passing out through the brass tube; when the exhaustion is carried to its utmost limit, let the air be re-admitted in a full gush through the brass tube, and the upper card will *not* be blown off.

This experiment has been tried many times, with various states of exhaustion, from a quarter of an inch of mercury to 20 inches; but in no case was the card blown off, or even agitated in the slightest degree: therefore the upper card is not retained in its position by the pressure of the atmosphere, but is retained in its place from this circumstance; that when a fluid issues from an open tube, the lateral or side pressure of such fluid amounts to nothing. This is an extraordinary fact, and we will endeavour to make the proof of it as simple as possible.

It is a well-known property of fluids that they transmit their pressure equally in all directions; but this law applies only to fluids in a state of rest. When they are in motion, they are subject to the laws which regulate the motions of solids, and do not transmit any lateral pressure, except when they meet obstacles to their onward motion. In proof of this conclusion we refer to an elegant experiment of Bossuet.

To a large reservoir of water, a horizontal tube was attached, three feet in length, and three quarters of an inch in diameter, and about the middle of this tube was made a small lateral hole, for the formation of a *jet d'eau*, the pipe being so adjusted, that the hole might be directed upwards, downwards, or sideways, by merely turning the tube on its axis. The water in the reservoir was kept to the height of four feet above the tube; and the extreme end of the latter being closed, the *jet d'eau* was immediately formed. When the hole was upwards, the jet rose very near to the surface of the water in the reservoir. The jet was obtained in like manner, whichever way the hole was turned. The end of the tube was now opened, the water began to flow out at it, and the jet ceased almost entirely. It was only observed that, when the hole was turned below, the water escaped in drops. The cessation of the jet clearly proves the cessation of the pressure of the water against the sides of the tube.

The young student may perform a similar experiment by taking a tube, (such as a pea-shooter or a tube of paper will do), and making a hole in the side. Then, if we put one end of this tube in the mouth, and stop up the other end, and blow, the air will rush out at the side-hole; but if we open the lower end, we shall, on blowing, be scarcely able to feel the air coming out from the side-hole. In the one case the air from the side-hole will blow out a candle; which it will not do when the tube is open at both ends.*

The reason then why the upper card cannot be blown off is this; the first impact of the blast tends, of course, by its momentum, to force off the upper

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*Not only will there be no outward jet of water or current of air from a lateral opening in a tube through which a current of water, or of air, is rapidly flowing, but both air and liquid will be *drawn in* to such a current or stream from the air or liquid surrounding the tube. This is demonstrated by an interesting experiment of Venturi. (Enquiries on the lateral communication of motion to fluids; or, Cavallo's Philosophy, Hydraulics, Chap. VII.); and to the pressure occasioned by the draught of air *into* the diverging current between the two disks, should be ascribed their card; and, if this be not done at once, the current of air spreads out into a film, and escapes at the circumference of the disks, and in so doing its motion is altogether lateral—the pressure of which, as we have seen, amounts to nothing: therefore the disk is not removed, because there is, in fact, no force to effect its removal.

This little experiment, trifling as it may appear, is, however, of first-rate importance, and may possibly serve to throw light upon some of the terrific explosions of steam-boilers. It is possible, under certain conditions, that the blast of steam which escapes at the safety-valve may become reduced to a thin film with a lateral motion, and consequently without pressure; so that the valve, instead of being lifted up, to allow a full and free vent to the steam, may become attracted, which attraction would increase with the elasticity of the steam, and so precipitate the danger which the valve was intended to counteract.

Mech. Mag.

On the most Economical Proportion of power to Tonnage in Steam Vessels.

By Mr. Scott Russell.

It is a subject of anxious inquiry with every proprietor and constructor of steam vessels, when about to construct a new steam vessel for a given station, What is the best amount of power to place in my ship, so as to accomplish, in the highest degree, economy, rapidity, and regularity? The inquiry is one accompanied with difficulties. If, on the one hand, a large cargo is desired, which is generally the case, the power of the engine is made small, for the purpose of occupying small bulk, and consuming little coal; and although less velocity is then acquired than with greater power, still less fuel is consumed with a small engine than a large one, and thus it is supposed that greater economy is effected. This maxim, of a small proportion of power to tonnage, is one on which many companies have long continued to act. In other cases, where velocity is absolutely required, a much larger proportion of power has been employed, and, of course, by a large power there is a much greater consumption of fuel than a small one in a given time; and not only so, but it is well known that this additional consumption is much greater than in the proportion of the velocity gained; so much so, that a consumption of four times as much fuel will not give more than about double the velocity. Thus, it has appeared that the use of very great powers, and great expenditure of fuel, have been made with only a very slight increase of velocity. All this, the usual reasoning on the subject, goes to prove the value of employing a small proportion of power to tonnage for economy. The advantage of low powers and of low velocities, in point of economy, would thus appear to be established: but this apparent advantage in theory has not been realized; on the contrary, it may be recollected, that at the Bristol Meeting of the Association, Dr. Lardner remarked, that in a case which had come under his own knowledge, where the power had become gradually increased in the same vessel, and it was found that while

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proximate adhesion, which seems to be left unaccounted for by the writer of the above paper. In the ingenious experiments of Hopkins Roberts, (Jour. Frank. Inst. Vol. X, p 188), the persisting force is ascribed to atmospheric pressure arising from an attenuated state of the compressed diverging current. This conflicts with the experiments of Tomlinson above recited; but the reasoning from those experiments appears to be inconclusive. G.

the vessel was increased in speed, the consumption of fuel on the whole had diminished. This was a fact which Dr. Lardner attributed to Mr. Russell's wave principle. Mr. Russell had himself attributed it at that time to the same cause, but he had afterwards considered the subject worthy of further examination. He examined the books of the expenditure of fuel in the steam vessels of several companies, and found that they were aware that they had, on the whole, saved money by using high powers of steam and high velocities, instead of low ones. This result he would not in the circumstances attribute to his wave principle; and he had, therefore, examined it carefully, and had arrived at a very remarkable general result, which appeared to him quite new, and to be of very great value at the present moment, when such important interests were involved in the successful extension of deep sea navigation. The general principle at which Mr. Russell had arrived, was this:—*That in a voyage by a steam vessel in the open sea, exposed, of course, to adverse winds, there is a certain high velocity and high portion of power, which may be accomplished with less expenditure of fuel and of room, than at a lower speed with less power.* This principle he then proceeded to prove, and to illustrate by the following case, in which the same vessel is taken with different powers of engine, and the result, as regards expenditure of fuel, determined first arithmetically, and then by a general formula, which will enable any one to determine any particular case.

Fair Weather.

1,200 tons, 400 horse-power, 9 miles an hour, 216 miles per day, 1 ton of coals per hour.—2,160 miles in 10 days, 240 tons of coal.

1,200 tons, 500 horse-power, 10 mile an hour, 240 miles per day, 1¼ ton of coal per hour.—2,160 miles in 9 days, 270 tons of coal.

Adverse Weather.

1,200 tons, 400 horse-power, 5 miles per hour, 120 miles per day, 1 ton of coals per hour.—2,160 miles in 18 days, 436 tons of coal.

1,200 tons, 500 horse-power, 6¾ miles per hour, 162 miles per day, 1¼ ton of coals per hour.—2,160 miles in 13 1-5th days, 395 tons of coal.

General Formula.—Let v represent the velocity of a given steam vessel in a favourable voyage; v' the same vessel in an unfavourable voyage; v'' a vessel, higher power, favourable voyage; v''' unfavourable voyage; p the power of the former vessel; p' latter vessel:—

$$\therefore \sqrt{v'''-(v-v')} = v''' = \sqrt{v\sqrt{\frac{p'}{p}-(v-v')}}\; v\frac{p'}{p} = \sqrt{\frac{v''-(v-v')}{v'}}$$

in the case of equal expense, whence the highest proportion of power that will be economical in fuel may be at once obtained.

Dr. Lardner remarked that the theory of Mr. Russell was quite new to him; but, after the exposition which he had heard, he was satisfied of its accuracy.—Mr. Russell observed that there was another important circumstance to which he had not alluded, and in which great advantage might be derived from the application of a high power: thus the owner of a vessel which usually accomplishes her voyage in fifteen days, but owing to storms or adverse winds, occasionally takes twenty, must so regulate her stated periods of departure as to allow for these adverse circumstances; and four or five such vessels may be required to keep up a regular communication between places for which three or four would be sufficient, if, by increased power, the average voyage were reduced to ten, and the adverse to fourteen days; and thus a large capital would be saved, as well as more voyages accomplished. The principles which he had developed might also, he thought, be applied advantageously under many other circumstances,—such as in mines subject to uncertain in-rushing of water, &c. In reply to a question, Mr. Russell stated that his principle was only true in reference to vessels making long voyages, for, where not exposed to adverse contingencies of wind and weather, a great additional power would be merely an additional expense.

Athenæum.

Great Western Railway.—The Box Tunnel.

One of the greatest obstacles to the accomplishment of this stupendous undertaking was found to exist in Box Hill, a large extent of elevated ground lying directly between, and about equi-distant from, Chippenham and Bath. This hill, the highest part of which is about four hundred feet above the proposed level of the rail road, could not be avoided; to make an open cutting through it was impossible, and to perforate it was thought by many equally so. Nevertheless Mr. Brunel, with that boldness for which he is so celebrated, adopted the latter plan, and accordingly it was determined that a tunnel, one mile and three quarters in length, forty feet in height, and thirty feet in width, should be made through the hill. The extraordinary attempt of boring through this immense mass, consisting in great part of solid beds of free-stone, was commenced in the summer of 1836, and will, it is hoped, be completed in 1841. The difficulties that have stood in the way of the performance of this great work, particularly that part of it on the east, or Chippenham, side, have been appalling; but hitherto they have been surmounted by the enterprise, skill, and perseverance of Mr. Brewer, of Rudloe, and Mr. Lewis, of Bath, the gentlemen who contracted with the directors for the completion of that portion of the work. Their contract extends from shaft No. 8, which is sunk at the proposed mouth of the tunnel on the east side, to a point three hundred yards towards Shaft No. 6, and altogether 2,418 feet from the entrance at the Chippenham end, this portion Messrs. Brewer and Lewis confidently expect to be able to finish in January next.

Independent of the difficulties arising from the laborious nature of the undertaking, the constant flow of the water into the works from the numerous fissures in the rock has been constantly most annoying, and in the rainy season so formidable as almost to destroy all hope of being able to contend with it. In November, 1837, the steam-pump then employed being quite inadequate to the task of making head against it, the water increased so fearfully, having filled the tunnel, and risen to the height of fifty-six feet in the shaft, as to cause the total suspension of the work till the July following. This would have caused many persons to have abandoned the work in despair, but Messrs. Brewer and Lewis determined to fulfil their contract if possible, erected a second pump, worked by a steam-engine of fifty-horse power, and had the satisfaction of vanquishing their enemy and resuming their work. A few months afterwards (in Nov. 1838) the works were again stopped by an influx of water, which, however, was got under in ten days, the engine discharged 32,000 hogsheads of water a day.

The tunnel between Shafts No. 7 and 8 (1,520 feet in length) is entirely finished at the roof, and for six feet below it, where the base is fourteen feet wide; but half-way between the two shafts there still remain about three hundred and fifty feet of cutting to be done, which is expected to be cleared away some time next month. In this portion of the work Messrs. Brewer and Lewis commenced their operations at each end, working towards the centre; and when the two cuttings closely approximated, much anxiety was felt lest a straight line should not have been kept, and the union of the two portions of the work should not have been true; but on breaking through the last intervening portion of the rock the accuracy of the headings was proved; to the joy of the workmen, who took a lively interest in the result, and to the triumph of Messrs. Brewer and Lewis' scientific working, it was found that the junction was perfect to a hair as to the level, the two roofs forming an unvarying line, while at the sides, the utmost deviation from a straight line was only one inch and a quarter. This, in a cutting of 1,520 feet in length, begun, at opposite ends, and worked towards a common centre is, perhaps, unexampled in the annals of tunneling.

The cutting on the Chippenham side has hitherto been, and it has already extended two thousand feet, through one solid bed of freestone or superior oolite, in many places one hundred and thirty feet thick, and lying upon a bed of fuller's earth, or clay, one hundred and twenty feet in thickness; under which, blue marl, resting upon lias clay, is found. So uninterrupted and compact is the rock through which this end of the tunnel passes, that no masonry is required in any part of it, the stone itself forming sides and roof, and nothing being required at the bottom but the rails on which the carriages will run.—*Abridged from the Wiltshire Independent.*

Civ. Eng, & Arch. Jour.

Railway Level Gauge.

Dr. Lardner described an apparatus which he had constructed for use in working railways: From various circumstances which he had observed, he was of opinion, that the rails were often not so perfect as they ought to be, and he had hence thought it advisable to make some experiments to ascertain their rate of deflection, his object being to form an idea of their relative merit of surfaces. He made use of a truck, with wheels without flanches and perfectly cylindrical, and on which a platform was placed. An iron tube crossed this, terminating at each end at right angles, and into this was introduced mercury, so that it was in fact a mercurial level. On placing this along the lines of railway the columns were found to go up and down, an effect which was not produced by oscillation. Into these columns was introduced a piston rod, to the top of which a pencil was attached, which on any incorrectness of the line described a curve on a sheet of paper, the ordinate of which gave the variation of the rail. He had tried this on several parts of a line, where it gave a continual variation in the curve, amounting even from three to five inches. The instrument was checked so as to show that this curve was the real representation of the line, and, being simple and easily applied, would no doubt be found useful to contractors on new lines of rails.

Athenæum.

Prices of Railway Shares in England.

The following table shows the prices of railway shares in England. Those finished are marked (1); in progress (2); which have their Bills, but are not yet begun (3); others (4).

Those marked with a * are the Liverpool prices, which are to the 26th inclusive. † Scotch. ‡ Manchester. § Carlisle. The others are London prices to the 28th July.

NAMES OF RAILWAYS.	No. of Shares.	Share.	Paid.	Prices sold at.			Dividend per cent.
				High-est.	Lowest	Latest Price.	
(2) Birmingham and Derby,	6,300	100*l*	70*l*	64	62½	64	
(2) Birmingham and Gloucester,	9,500	100	50	32¼	29	32¼	
(2) Birm., Brist., & Thames Junc.	7,500	20	18			9	
(2) Bristol and Exeter,	15,000	100	25	10¾	10	10	
(2)‡Bolton and Preston,	7,000	50	20	11½	11	11	
(2)‡Cheltenham and Great Western,	7,500	100	35	11	10	10	
(2)*Chester and Crewe,	5,000	50	30	19½	19½	19½	
(2)*Do., Birkenhead,	5,000	50	35	42½	40¼	42	
(2) Commercial, Blackwall,	24,000	25	11	10	8	9⅞	
(2)‡Dublin and Drogheda,	6,000	100	10	8	8	8	
(2)*Eastern Counties,	64,000	25	16	10⅛	7⅜	7⅜	
(2)*Edinburgh and Glasgow (old),	18,000	50	10	10⅛	10⅛	10⅛	
Ditto, ditto (new)	5,000		5			4	
(2) Edinburgh, Leith, & Newhaven	5,000	20	7			4	
(2)†Glasgow, Paisley, & Greenock,	16,000	25	18	10	9¾	10	
(2)†Glasgow, Paisley, & Ayrshire,	12,500	50	20	16	15	16	
(1)*Grand Junction,	10,400	100	100	204	202	203	12
(2) Gosport Junction,	6,000	50	5	8½	7½	8	
(2) Great Leinster and Munster,	8,000	100	5			18*s* 6*d*	
(2) Great North of England,	10,000	100	35	26	25	25	
(2)*Great Western,	25,000	100	65	73	71	72	
*Do. new,				3¾pm.	2⅝pm.	3¼pm	
(4) Harwich,	11,000	20	1			⅝	
(2)‡Hull and Selby,	8,000	50	30	19½	15	19½	
(2) Llanelly Railway & Dock Co.,	2,000	100	70			70	7½
(1)*Liverpool and Manchester,	7,968¾	100	100	196	195	195	10
*Ditto ¼ shares,	546	25	25	46½	46¼	46½	
*Ditto ½ shares,	7,968	50	50	76	75¾	75¾	
(1)*Leicester and Swannington,	1,500	50	50	73½	70¼	73¼	8
(2) London and Brighton,	36,000	50	22	12¾	11⅜	11½	
(1) Do. and Birmingham,	25,000	100	90	166	160	166	
Do. ¼ shares,	25,000	25	5	27½	27	27	
Do. New Shares,			8	25¼	24	25¼	
(1) Do. and Greenwich,	20,000	20	20	16½	15½	15½	3
Do. New Shares,			20	19½	19½	19½	
(2) Do. and Southampton,	20,000	50	50	45½	43½	45	
Do. do. New,	16,000	25	25				
(1) Do. and Croydon, Trunk,	20,000	20	16⅞	12⅝	10	10½	
Do. New Scrip,	6,666	20	10½			8¼	
(1)‡ Leeds and Selby,	2,100	100	100	70	70	70	
(2) Manchester and Birmingham,	30,000	70	15	12	9½	10⅝	
(4) Do. and do. Extension,	15,000	70	7	5¼	3¼	3¼	
(2) Do. and Leeds,	13,000	100	50	69½	59½	69½	
‡Do. New Shares,	10,000	50	5	10	10	10	
(2)§Maryport and Carlisle,	4,000	50	32	7	7	7	
(2) Midland Counties,	10,000	100	70	55	55	55	
(1)§Newcastle and Carlisle,	6,000	100	100	105	105	105	
§Ditto ¼ shares,		25	25	26	26	26	
(2) Northern and Eastern,	12,000	100	18	7½	6¾	6¾	
(2) North Midland,	15,000	100	75	71	60½	71	
(1)*North Union,	3,200	100	100	67½	67½	67½	
Do. New Shares,	3,200	50	50			64½	
(2) Preston and Wyre,	2,600	50	44			42	
(4)‡Sheffield and Manchester,	7,000	100	10	4	4	4	
(2)‡South-Eastern and Dover,	28,000	50	12	4½	4	4½	
Do. New Shares,			15	4⅛	3¾	4	
(1) St. Helen's, Runcorn Gap,			100			40½	
(1)§Stockton and Darlington,	1,000	100	100	205	205	205	14
(2) Thames Haven,	9,000	50	5				
(2) York and North Midland,	6,700	50	30	40½	30	37½	

Wooden Pavements.

To the Editor of the Repertory of Patents.

Sir,—Observing a number of blocks of wood lying in the Old Bailey, evidently prepared for being laid down to form a wooden pavement for the carriage way opposite the Sessions House, and finding the blocks to vary greatly in dimensions, I measured several of them, and found some only eight inches and a half long, while others were nine inches and three eighths. They are generally of the figure of a regular hexagonal prism, some of them, however, are a little conical, but the diameters vary so much, that it will be impracticable to fit them together, without leaving interstices between them, so great as to render the outer parts of blocks, liable to be chipped off by the feet of the horses and the wheels of the carriages passing over them.

The surface too of the ends of the blocks, each of which ought to be cut off exactly at right angles to the axis of the prism, forms, in many cases, oblique angles with that axis, and consequently, when the blocks are placed end upwards, one side will be higher than the other, and thus the pavement will necessarily have an uneven surface, and much of the value of the wooden pavement be lost.

Having attentively watched, for about four years, from 1827 to 1831, the effect of much traveling over a wooden pavement well executed in the principal gateway of Vienna, and observed that it appeared to wear much less than any other kind of pavement, I frequently, after my return to England, mentioned to our engineers the superiority of wooden blocks, placed with the end of the grain upwards for a carriage way, and recommended their universal adoption.

But the goodness and durability will depend on the excellence of the workmanship; the blocks ought all to be cut exactly to one gauge, and laid on an even bed; I should consider a difference of a tenth of an inch in either length or breadth, sufficient to disgrace any engineer, who would permit such blocks to be laid down contiguously. How great then must be my disgust at observing nearly an inch difference in the lengths, and more than an inch in the breadths, of those blocks about to be used in the Old Bailey.

Being thoroughly satisfied that neither comfort nor durability can possibly result from such excessively bad workmanship, and apprehensive that the numerous benefits and great economy of wooden pavements, will, for a length of time, be lost to the community if such a wretched specimen be allowed to influence public opinion, I deem it my duty to warn all those concerned, against a proceeding, which can only produce disappointment and public injury. I am Sir, your obedient servant,

John Isaac Hawkins,
Civil Engineer and Patent Agent.

Rep. Pat. Inven.

Steamboats in France.

The number of steam-boats in France has been very much increased lately, and the majority of the vessels are supplied with English engines. The engines are chiefly on the low-pressure principle, and are worked by English engineers, of whom there are twenty in the ports of the Seine only. The rate of pay is about 300 francs, or twelve pounds, a month, and board; while the pay of the captain of a river steamer is only 150 francs, or six pounds, a month, with board. The words of command in all these vessels are English,—"stop her," "head way," "back her," &c., surprise the passenger, and afford an interesting proof of the influence which the English nation exercises abroad. The stokers are partly English, partly French, and some American negroes. The crews, especially of the river steamers, are a wretched set of lubbers, talking much more than they work, and causing all kinds of accidents and delays. The management is excessively bad, and the steersmen of the river steamers, who are pilots of the Seine, get intoxicated, and ask drinking money from the passengers. The strongest part of the equipage is certainly the crew of cooks and waiters, who are seldom less than half a score, with a regular *cuisine* at their disposal, to the gratification of the passengers' olfactory nerves. Most of the engines on the Paris and Havre stations have been supplied by Mr. Barnes, of London, late Barnes and Miller. The Seine steamers are very long (about 150 feet) and narrow, drawing only about two feet water, and yet in summer they often take the ground. In winter they cannot run, as the height of the water leaves no space to pass through the bridges. Iron boats have been recently introduced, and with good effect. Boats run from Paris to various places in the neighbourhood, but most of those for Rouen start from Pecq, a suburb of St. Germain, at the termination of the railway. From Rouen numerous boats run both up and down the river, and from Havre there is steam communication to Bourdeaux, Cherbourg, Caen, Dublin, Plymouth, Southampton, Portsmouth, London, Dunkirk, Rotterdam, Hamburgh, Copenhagen, and St. Petersburgh. Dunkirk is also a rising steam station, and communicates with Havre, Hull, and Rotterdam. At Havre the government propose to build a large steam dock for the navigation to the United States, in which they are desirous of participating with the English. Steamers now go from England to a great number of ports on the French coast, so as to make the union between the two nations still more intimate. A great part of the steam-boat passengers, if not the majority, are, however, English. Among these ports are Dunkirk, Calais, Boulogne, Dieppe, St. Valery-sur-Somme, Havre, Granville, St. Malo, and Bourdeaux. On the English side the communication is to Hull, London, Margate, Dover, Rye, Brighton, Portsmouth, Southampton, Weymouth, Plymouth, and Dublin. The surf of the steamers on the river Seine is very great, arising from the shallowness of the channel, on the sand banks of which the steamers are obliged sometimes to scrape their way. Small boats always make for the shore, and if they can, run up high and dry, boats lying on the banks being not unfrequently swamped. The few craft on the river Seine are principally Rouen boats, a long unwieldy barge, which obeys the helm with difficulty, and frequently embarrasses the channel. The coals used are partly English, from Newcastle, and partly Belgian, and the coke used is Belgian. Some of the engines are kept in very good order, but others are extremely dirty and rusty from the negligence of the engineers. Railway Mag.

Locomotive Power applied to Canal Transit.

On the 21st and 22d instant, an experiment was conducted on the Forth and Clyde Canal, of a novel and highly interesting nature, by John Macneil, C. E., and consulting engineer to the Canal Company. It is well known that the haulage of boats on this canal has hitherto been performed by horses, the rates of speed being for the heavy sloops, brigs, &c., in the London, Dundee, and other trades, about 1½ to 2 miles per hour, when drawn by 2 or 5 horses, according to the state of the weather, and for the swift or passengers boats, between 8 and 9 miles per hour, on an average, when drawn by two horses. The object of the experiment was to ascertain the possibility of using locomotive steam power to draw the boats instead of horses; accordingly, a single line of rails, upon blocks, like an ordinary railway, was laid down for a considerable space along the canal banks, near lock 16; and a locomotive engine and tender, built by Mr. William Dodds, having been brought down the canal and set on the rails, on the morning of the 21st, Mr. Macneil, Mr. Johnston, the canal director, and several engineers and gentlemen, being present, the experiment commenced by attaching to the engine the towing line of the first passenger boat that made its appearance, and which contained upwards of 90 passengers, with their luggage. There was a trifling delay in disengaging the horses and tying the line to the engine, but this was amply compensated when the "Victoria" briskly set off, and almost immediately gained a speed of 17⅓ miles per hour, which she kept up round two curves, and until the termination of the rails made it necessary to stop, amid the cheers of the delighted passengers. This experiment was repeated, during the course of the day, with each passenger boat as it came to the railed space, and with equal success each time. On one occasion a towing rope, which was much decayed, got foul with a curb-stone and broke, but without causing the slightest inconvenience, except about one minute's delay. The engine employed being intended only for a slow trade, was not calculated to go at greater speed than 18 miles per hour, but it was the opinion of all present, that with proper passenger locomotives, a speed might be obtained, equal to that upon the best railways, few of the latter possessing the advantage secured by the canal bank of a *perfect level* throughout.

The nature of the motion was highly gratifying to all the passengers, being more uniform, steady, and smooth, than when the boats were drawn by horses.

Several of the heavy (masted) vessels were also taken in tow during the two days of trial, at the rates of 3, 3½, 4 and 5 miles per hour; and, on one occasion, two loaded sloops, and a large wagon boat, were together attached to the engine, and hauled with ease at the rate of 2¾ miles per hour, whilst only *one-fourth* of the steam was allowed to pass the throttle valve.

The foregoing statements render palpably apparent the immense advantages which might be gained by this new adaptation of steam power—a great economy in haulage expenses, as one engine might draw, at least, six sloops, which now would require from 18 to 24 horses, and, if necessary, at double the present speed; and a proportional increase of the important traffic on the canal, which might be reasonably expected.

Passengers would increase in a great proportion, when attracted by economy and speed of transport. The Union Canal might be traversed in two hours, and the Forth and Clyde Canal in 1½, instead of 4 hours and 3½, as at present, and this by only assuming 16 miles per hour, though more might easily be performed, as the experiments have shown. Lond. Mech. Mag.

Newly discovered Power in Projectiles.

An experiment was tried early on Thursday last with a newly-invented projectile. A large and strong-built boat was the subject of the experiment; the distance was left to choice, with the single proviso, that the object fired at should be in sight. The inventor, Captain Warner, launched with his own hand the destructive missile, which, reaching the boat at the water-line, exploded, fairly heaving her up, and scattering the planks into shivers. One plank alone of the whole retained a breadth of about three inches, and perhaps two feet in length; the rest, and the keel itself, as they fell after the lapse of some seconds into the water, presented a mere mass of floating splinters to the eye, and portions of the wood were carried into the neighbouring fields to a considerable distance. The whole destruction was effected by the agency of two and a half pounds of combustible matter projected by an instrument of perhaps ten or a dozen pound's weight. There was no recoil whatever, nor any smoke or noise till the shell itself exploded against the vessel, and then the percussion of air was tremendous, as it threw down the nearest spectator, and was felt at a still greater distance like the discharge of an eighty-pounder, at least. At Kingston it created great commotion, as the explosion was attributed to the powder-mills at Hounslow; and since the fact has become known the excitement has greatly increased. No vessel of the line, probably, could have resisted the shock, or escaped total destruction from even the small quantity of combustibles experimented with. The most singular circumstance, perhaps, is, that not the slightest discoloration was visible on any of the fragments. The power consequently is quite novel, and the secret jealously guarded.—*Morning Chronicle.*

Athenæum, July 13, 1839.

Opening of the Versailles Railway.

This railway branches off from that of Paris to St. Germain, and passes through a rocky and troublesome country. On the 27th of April, 1837, the law was passed authorising Messrs. Rothschild to execute it; and on the 4th inst. it was opened, having taken not more than two years and three quarters for its completion. It was originally intended to have had an independent entrance into Paris, but by an agreement with the St. Germain Railway, the two lines have been united, so as to have a common depot. The line seems efficiently constructed, and the rails well laid, and the locomotives perform their duty satisfactorily. They are of English make, and were manufactured by Messrs. Sharpus of Manchester; the working engineers are also English. At an early hour in the morning the office was beset with a great crowd, awaiting the opening of the doors, and in the course of the day it was calculated that fifteen thousand persons were carried, realizing above forty thousand francs, or about sixteen hundred pounds. Being on Sunday, a great crowd was attracted, not only from Paris, but from the neighbouring towns, to witness the ceremony of the inauguration. The municipality had expressly reserved for this occasion the second celebration of the fetes of July; the grand waterworks played in the park, fireworks were let off in the evening, and amusements of all kinds united to attract to Versailles the greatest number of visitors which had ever been assembled in the town. Railway Mag.

Steam Vessel Propellers.

A new kind of propeller, on the principle of a fish's tail, has been invented, to work under water, as the Archimedean screw. Experiments were tried with it on the Grand Surrey Canal, in comparison with the screw, of which the following is an extract from a letter we have received:—"The distance measured was 10 chains, or $\frac{1}{8}$th of a mile. Six experiments were made; first, with the *new* propeller; secondly, with the screw. Each propeller was fitted to the same boat, which was 27 feet in length, 4 feet in breadth; and 1 foot in draught. There were four persons in the boat, and their weight, including the ballast, &c., might be about one ton. The circumstances as to the trim of the boat, the machinery and size of propeller, &c., were entirely the same. The results of six experiments on each of the propellers were as follows:—

New Propeller, moving through 10 *Chains Distance.*

Time.	Revolutions of Winch.	Revolutions of Propeller.	Rate of velocity in Miles per Hour.
140 secs.	90.3	451.3	3.4

Screw Propeller, moving through 10 *Chains.*

230	156.3	781.3	2.5

"The action of the new propeller was beautifully regular. No commotion in the water, no vibration in the boat, or counter steering, to suit the irregularity of the action of the screw, as in the case of the Archimedes, where the vibration from that cause was excessive; so much so, indeed, as to have worn the bearing of the shaft of the screw nearly 1-16th of an inch on one side; whereas, the new propeller glided through the water as smoothly as the tail of a fish, which furnished the idea for its form. As soon as the whole of the experiments are reduced, you shall have a copy of them."

Ibid.

Mechanics' Register.

Telegraphs in the Bristol Channel.

We learn from the *Bristol Mirror*, that the Town Council of Bristol have under consideration the propriety of establishing a line of telegraphs in the channel, in contemplation of its becoming the station for the South American and West Indian steamers.

Railway Mag.

Electric Superstition.

A few days since, a young man was killed by lightning, in the church of Epfig, in the Bas Rhin, while the bells were ringing to drive away the storm, according to the common superstition prevalent in many parts of France. This new proof of the danger arising from the practice has induced the Prefect of the department to issue an ordinance strictly forbidding it.

Ibid.

Metropolitan Patent Wood Pavement Company.

Capital £120,000 *in* 6000 *shares of* £20 *each. Deposit* £3 *per share.*

This Company, which has been introduced under very influential patronage, but which, in itself, is to us no proof of the value of the patent sought to be applied in this country, of introducing "wood pavement for the carriage ways of the metropolis," appears, if the principle be good, to be one which only requires an active and economic management to render successful. No longer do our advertising columns teem with asphalte companies; the material rendered by them has been fairly subjected to the test of experience, and has failed in the accomplishment of the desired objects which were, in their several prospectuses, represented as being attainable, although for certain uses, it must be admitted, that asphalte is well calculated to supply the place of other materials. Thus, being again thrown back on the use, in the metropolis, of granite blocks or Macadamised road ways, we are subjected either to noise, mud, or dust, by the one or other application, in addition to which the Macadamised process is attended with a very serious expense. If, then, (and some proof has been already afforded,) "wood pavement" can be laid down economically, and that it will be lasting, there can be no doubt but it must come into general use, and, therefore, the prospects of a company are of an encouraging nature.

There is another company for the same object, but what are the peculiar features or advantages of each are unknown to us. A patent having been taken up in this instance, would imply an improvement; this, however, is to be seen. Mining Jour.

Artesian Well at Grenelle.

At the last setting of the Academy of Science, M. Arago stated that he had that morning been making some thermometrical experiments at the Artesian well at Grenelle, in order to ascertain the temperature at the depth which had already been attained, viz., 483 metres, or 1584 feet. When the workmen had reached 460 metres the chalk was of a green colour, indicating the proximity of water. Since then the chalk had become mixed with clay, and of a dark colour, a still stronger indication that the sheet of water which it is intended to meet is near. M. Arago used the thermometer of M. Walferdin, and after having taken all the necessary precautions in order that the pressure, which at such a depth is equal to fifty atmospheres, might not injure the bulb, six thermometers of the same kind were successively let down to a depth of 481 metres, care having been taken not to lower them until thirty-six hours had elapsed after the boring, in order that the heat which this work might have communicated should have subsided. The thermometers were left in the well for thirty-six hours. The heat at this depth was twenty-seven degrees of Reaumur, or 92¾ of Fahrenheit, being about twenty-three metres for each degree of temperature. M. Arago expressed a hope that no water might be found for 100 metres more, as in that case there would be a permanent hot spring at the very gates of Paris. Mining Review.

Dowie's Patent Boots and Shoes.

When the foot is under the pressure of the body, it is elongated. This principle of elongation seems to have been long admitted, inasmuch as all boots and shoes have hitherto been made a little longer than the foot of the wearer; but the difference in the degree of extension in the feet of different individuals appears to have been, in some measure, overlooked, as it rarely happened that allowance was made for this difference; and the result has been, that many persons have never obtained shoes long enough for their feet, when thus extended, the measurement being generally taken when the foot is not under the pressure of the body. Another important consideration arises, from the circumstances connected with the altered positions of the foot in walking. As the foot extends in length from heel to toe, in proportion to the height of the arch, the strength of the ligaments, and the weight it has to support, the elongation has been found, by actual measurement, to vary from a quarter of an inch to a whole inch. * * *

Many years ago, I was much impressed with the imperfections in the structure of the boots and shoes in general use. After devoting much time and attention in endeavouring to remedy their defects, I believe that I have at length succeeded in attaining this object. This is effected by making those parts of the boots or shoes immediately under, and on each side of, the principal arch of the foot of an *elastic material.* This material is composed of caoutchouc and animal skin, so manufactured as to bestow on the fabric the elasticity of the caoutchouc, while it retains the tenacity and durability of leather. The introduction of this elastic substance allows considerable changes to be made in the form of the boots and shoes, and gives the wearer the free use of his feet and ankle joints in walking, to a much greater extent than any hitherto in use.—*Trans. Soc. of Arts of Scotland.*

Lond. Mech Mag.

Wire Sewn Boots and Shoes.

M. Sellier of Paris, has secured by a patent in France the right of using brass wire for attaching the upper leather to the welts of shoes and boots. He urges that this metallic thread allows neither moisture nor dust to enter the shoe, and furthermore that it does not rip. The sewing is performed with as much ease, as with waxed thread, nor is the work more costly. A member of the committee has worn a pair of Sellier's boots 18 months, in which time two strong soles were worn out, without any giving way whatever of the wire sewing. They were free from dampness, and from dust in a time of drought. *Bull. d'Encour. Sept.* 1838.

Statue of Dr. Dalton.

This statue, it appears, is completed, and now exhibiting at the Royal Institute. It is of white marble, remarkably clear from blemish. The proportions are colossal; the venerable philosopher is represented as seated in his study chair, in his robe as a doctor of civil law; and his usual posture has been preserved with considerable skill, taste, and good effect. His right elbow rests on the chair; three of the fingers support the chin, and the fore finger extends upwards towards the ear. His left arm is upon that of the chair, and the hand rests upon the upper edges of a volume, which is supported by the seat. His left leg is crossed over the right knee, and the left foot, which would otherwise be unsupported, rests upon a crucible, in which is a retort; and upon the ground beside them is lying a scroll, inscribed with some of the symbols used by the Doctor in denoting the atomic composition of bodies. In a shield at the back of the chair is engraven "John Dalton, D.C.L." and on one side, "Francis Chantrey, sculptor, 1837." —*Manchester Guardian.* Athenæum.

Wood Engraving Machine.

The practice of engraving the outlines and rivers on wood, and then piercing the block and inserting the names of the places in type, has lately been revived; and where publishers are obliged either to print maps with the type, or to give none at all, this mode may answer very well, more especially when the object is to give the relative position of a few of the principal places, rather than a crowded list of names. Most of the larger maps in the *Penny Cyclopædia* are executed in this manner. The holes in the blocks are pierced with the greatest rapidity by gouges of different sizes acting vertically, and put in motion by machinery contrived by Mr. Edward Cowper, to whose great mechanical skill the art of steam printing chiefly owes its perfection.—*Jackson's Treatise on Wood Engraving.*

Lond. Mech. Mag

New Alloys of Metals.

A curious and valuable discovery has just been made in the alloy of metals. A manufacturer of Paris has invented a composition much less oxidable than silver, and which will not melt at less than a heat treble that which silver will bear; the cost of it is less than 4*d.* an ounce. Another improvement is in steel; an Englishman at Brussels has discovered a mode of casting iron so that it flows from the furnace pure steel, better than the best cast-steel in England, and almost equal to that which has undergone the process of beating. The cost of this steel is only a farthing per pound greater than that of cast-iron.

Mining Jour.

New mode of Illuminating Clocks.

The Horse Guards clock was illuminated for the first time, on Tuesday, July 16, by means of the "Bude Light," which falls on the face; thus differing from the ordinary transparent clocks, to which it is much superior, both in clearness and beauty. It gives the clock-face an appearance of being shone upon by a very powerful moonlight.

Lond. Mech. Mag.

Artificial Ivory.

Certain parties in Sheffield have just obtained a patent for the making of a substance so nearly resembling ivory, and so applicable to all the purposes of that valuable material, that it is almost impossible to detect the difference. —*Sheffield Iris.*

Mining Rev.

Machine for Copying Oil Paintings.

M. Liepmann, a painter of eminence at Berlin, is stated to have invented a mechanical process for taking, in a very short time, a copy of any painting in oil, however old, with an exactitude which cannot be attained by the brush. M. Liepmann has exhibited his machine in the galleries of the Royal Museum at Berlin, and in the presence of the directors, made 110 copies of a portrait of Rembrandt, with the greatest success.—*Morning Herald.*

Athenæum.

LUNAR OCCULTATIONS FOR PHILADELPHIA, FEBRUARY, 1840.

Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜

Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
10	10	41	Im. m Pleiadum	7	90°	147°
10	11	42	Em.		284	338
16	16	20	Im. ν Leonis	5.6	359	51
16	16	52	Em.		294	348
17	5	51	Im. ρ Leonis	4	102	53
17	6	37	Em.		212	161
17	7	24	Im. 49 Leonis	6	9	318
17	8	0	Em.		299	248
21	11	22	Im. 85 Virginis	6	51	7
21	12	32	Em.		238	202
27	17	29	Im. τ Sagittarii	4	111	77
27	18	52	Em.		261	242

Meteorological Observations for August, 1839.

Moon.	Days	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.	Direction	Force.		
				Inch's	Inch's			Inches.	
	1	68	80	29.76	29.85	W.	Moderate.		Clear—do.
☽	2	64	66	.86	.85	N.E.	do.	.35	Rain—do.
	3	65	76	.60	.84	N.W.	do.		Cloudy—do.
	4	63	77	.50	.95	N.E.	do.		Clear—partially cloudy.
	5	64	79	.90	.90	N.E.	do.		Clear—cloudy.
	6	66	79	.90	.86	S.W.S.	do.		Clear—do.
	7	70	82	.84	.84	W.W.	do.		Clear—do.
	8	68	74	.70	.60	S.	do.	.25	Cloudy—showery.
⊗	9	68	77	.59	.57	N.	Brisk.		Clear—do.
	10	60	78	.70	.80	W.	Moderate.		Clear—do.
	11	60	80	.86	.90	W.	do.		Clear—cloudy.
	12	68	80	.90	.90	W.S.W.	do.		Cloudy—clear.
	13	64	78	30.00	30.00	N.	do.	1.20	Clear—do.—rain.
	14	60	76	.10	.10	W.	do.		Clear—clear.
	15	64	78	.10	.10	W.S.W.	do.		Clear—cloudy.
	16	58	62	29.70	29.70	N.E.	Gale.	1.25	Rain—rain.
☾	17	62	68	.80	.85	E.	Calm.	.75	Cloudy—showery.
	18	62	72	.90	.90	S.E.	Moderate.		Clear—cloudy.
	19	64	70	.90	.90	E.S.E,	do.		Fog—cloudy
	20	68	75	.90	.90	N E.	do.		Cloudy—partially do.
	21	69	77	.90	.90	S.	do.	.15	Cloudy—clear—rain.
	22	67	76	.86	.86	S.	do.	.20	Cloudy—rain.
☼	23	69	79	.80	.80	S.S.E.	do.		Cloudy—do.
	24	69	74	.76	.76	S.	do.		Cloudy—do.
	25	70	81	.85	.85	W.	do.	. 2	Rain—clear.
	26	69	83	.85	.85	S.W.	do.	.25	Clear—do.—rain at night.
	27	72	82	.80	.80	W.	do.	. 2	Partially cloudy—clear—rain.
	28	68	76	.85	.85	N.E.	do.		Cloudy—clear.
	29	56	62	.85	.95	N E.	do.		Cloudy—do.
	30	52	51	.80	.80	N E	Brisk.	.48	Rain—do.
	31	54	66	.90	.90	W.	Moderate.		Cloudy—do.
	Mean	64.55	74.66	29 83	29.86			4.92	

	Thermometer.		Barometer.	
Maximum height during the month.	83.	on 26th.	30.10	on 14th. & 15th.
Minimum “ “	51.	30th.	29.50	4th.
Mean	69 605		29 845	

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